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INSECTS ATTACKING CABBAGE AND ALLIED
CROPS IN CONNECTICUT



FIG. 1. Cabbage Field showing damage by Cabbage Maggot.

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INSECTS ATTACKING CABBAGE AND ALLIED CROPS IN CONNECTICUT

By W. E. BRITTON AND QUINCY S. LOWRY.

The object of this bulletin is to place in the hands of vegetable growers a single publication giving information about the insects attacking cabbage, cauliflower, and allied plants in Connecticut. The subject matter is not entirely a compilation as the senior author has made observations on the insects in the state for many years, and for the past two seasons definite experimental work has been carried on by the junior author to control the cabbage root maggot.

CABBAGE ROOT MAGGOT: *Phorbia brassicae* Bouché

The most important insect pest of early cabbages in Connecticut is the root maggot, which attacks not only cabbage, but also other allied plants such as cauliflower, turnip and radish.

This insect is a native of Europe, and was introduced into this country probably by accident, making its first appearance in Massachusetts more than seventy years ago. According to published statements it has now spread throughout the United States and Canada, and caused injury wherever its food plants are grown. Some entomologists, however, consider this questionable and regard another species, *P. fusciceps* Zett., which is a general feeder, as responsible for the injury in the Southern Atlantic states. Be this as it may, the insect surely causes severe damage in the northern and eastern states and seems to be on the increase, though Dr. J. Fletcher, as early as 1885, reported it as destroying from 25 to 75 per cent. of the cauliflower plants in Canada. The damage to early cabbages was especially serious in Connecticut in 1915. The maggots feed upon and tunnel in the main stem and larger roots just below the surface of the ground as shown in figure 2, greatly reducing the vitality of the plants and often causing them to wilt and die. Plants which have been moderately or severely injured will not recover and make satisfactory heads, even though the maggots are killed. This insect

seldom injures cabbages late in the season but often causes serious injury to turnips and radishes.

Description and Life History.—The maggots are the larvae of a small, two-winged fly which lays eggs on or near the stem of the plant, usually just beneath the surface of the ground late

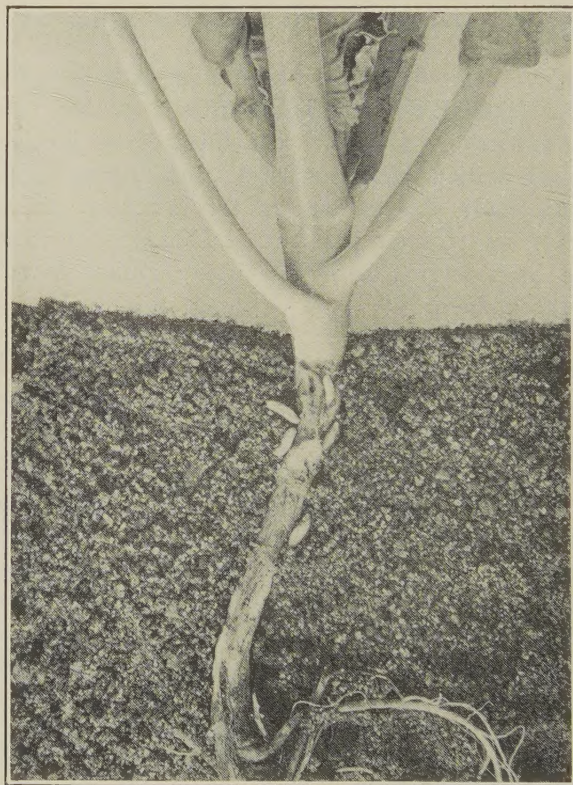


FIG. 2. Young Cabbage Plant showing Maggots on outside of Stem. Natural size.

in April or early in May. There are at least three and possibly four broods each year. The second brood appears about the middle of June, but it is only the first brood that seems to cause serious damage to cabbage and cauliflower crops.

Egg.—Pure white, oval, about 1 mm. or $1/25$ of an inch in length. Though eggs are deposited separately, each female

averages between 50 and 60 eggs. These eggs hatch in from three to five days according to climatic conditions.

Larva.—When fully grown the maggot is about 8 mm. or $\frac{1}{3}$ of an inch long and yellowish white in color. It has no legs and is quite helpless: if it hatches far from its food plant it is sure to perish. It cannot bite but its mouth-parts enable it to scrape away the tissues of the host plant, which soon begins to decay, thus making it easier for the maggots to penetrate. From three to four weeks are required for the maggot to reach maturity.

Pupa.—When mature the larva or maggot leaves its host plant, descends an inch or more into the soil and transforms to the pupa stage by utilizing its outer skin for a shell or puparium after the

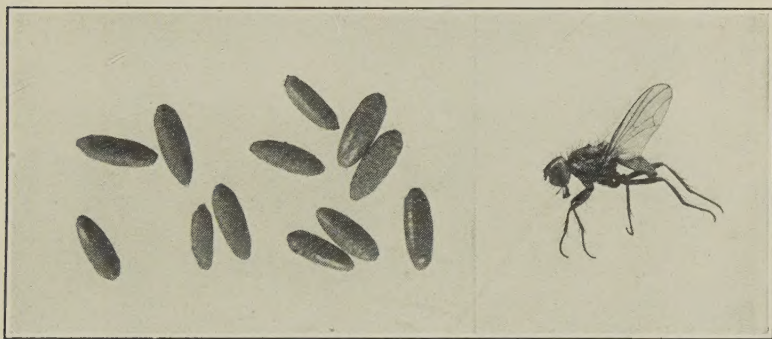


FIG. 3. Puparia and Adult of the Cabbage Maggot. Enlarged.

manner of flies. The brown pupae are abundant in Connecticut about the middle of June. This stage usually requires about two weeks, though with the late fall brood it lasts through the winter, the pupae being found as late as May 7th the following spring.

Adult.—The two-winged fly is gray with thorax and abdomen more or less irregularly marked with black. It somewhat resembles the common house fly, though smaller, and the female is lighter than the male and has fewer distinctive characters. The male has a tuft of bristles on the under side of each femur which distinguishes it from allied species. Adults are known to pass the winter in stubble in the field and in similar places where they can find protection. Adult and puparia are shown in figure 3.

Natural Enemies.—A number of predaceous and parasitic insects are known to attack the cabbage root maggot. A small

spider, *Trombidium*, sucks the eggs. Some of the rove beetles (family Staphylinidæ) devour large numbers of maggots. Several four-winged flies are known to be parasitic on the cabbage maggot, and in Minnesota a few years ago three new species, one a serphoidid, *Loxotropa pegomyæ* Brues, and two

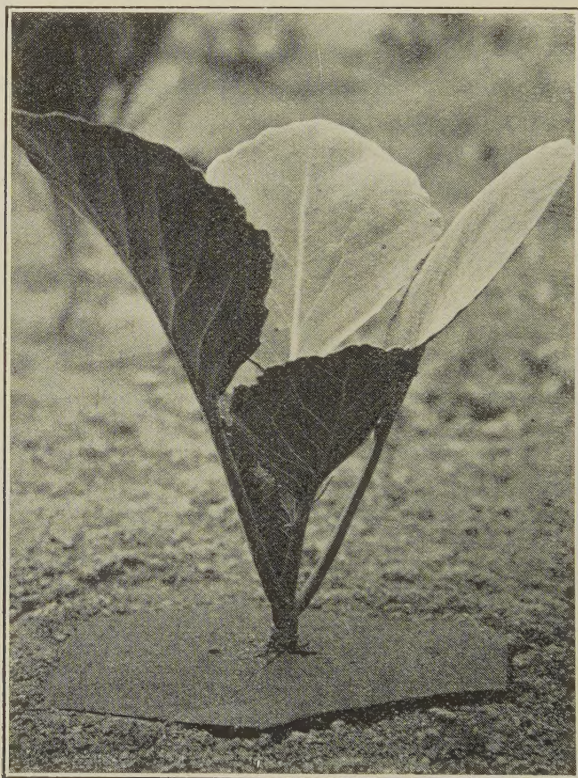


FIG. 4. Plant Protected by Tarred Paper Disk.

ichneumonids, *Mesocrina pegomyæ* Brues and *Aphareta pegomyæ* Brues, were reared from the puparia.*

Control Methods.—The most effective and economic method of control is to place around the stem of each plant, soon after setting, a disk of tarred paper as shown in figure 4. These disks

* Report of Minnesota State Entomologist for 1907-1908, page 192.

may be purchased from Hirsch Bros., 2257 Metropolitan Ave., Middle Village, N. Y.; Smith Bros., Green Bay, Wis.; A. B. Cowles, 25 South Water St., Rochester, N. Y., or they can be cut at home as shown in figures 5 and 6.

In our experiments at the Station Farm, Mt. Carmel, in 1915, the insect was very abundant and caused a loss of 23.3 per cent. of the untreated plants, though close beside them where the tarred paper disks were applied there was a loss of only 4.4 per

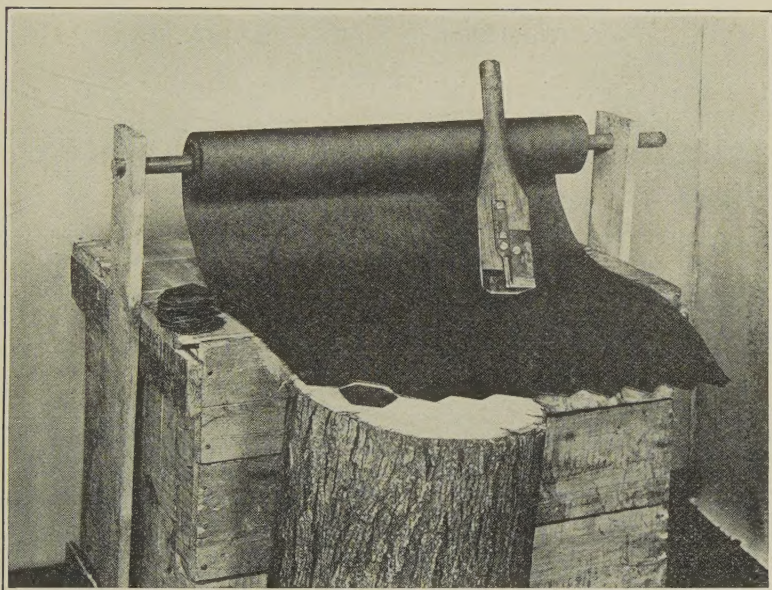


FIG. 5. Tool and Device for Cutting Disks.

cent. The carbolic acid emulsion treatment permitted a loss of only 6 per cent. The difference is shown in figure 7. Similar results have been obtained in preceding tests.

Perhaps the second most effective control method is to pour into a surface depression around the stem of each plant about three fluid ounces of crude carbolic acid emulsion made after the following formula:

Hard soap, 1 lb., or soft soap, 1 qt.
Boiling water, 1 gal.
Crude carbolic acid, 1 pt.

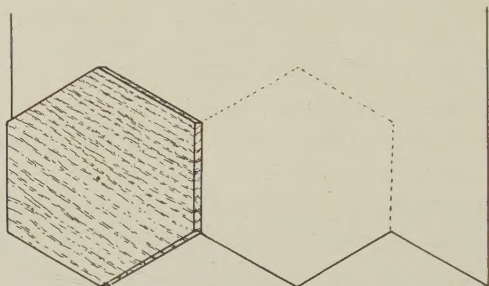


FIG. 6. Wood Form for cutting Hexagonal Disks.

Dissolve the soap in the boiling water, add the acid and churn as in making kerosene emulsion. This mixture thickens on cooling and should be diluted with 30 times its bulk of water before using.



FIG. 7. Plants at left were protected by Tarred Paper Disks; injury less than 5 per cent. Those at right were untreated; nearly one-third were injured.

Clean culture, destruction of infested stumps and other rubbish, and crop rotation are important practices in controlling the cabbage maggot.

THE IMPORTED CABBAGE WORM OR BUTTERFLY.

Pontia (Pieris) rapæ Linn.

This is the larva of the common white cabbage butterfly, a well-known European pest which was introduced into Canada about 1860, and has since spread nearly all over the United States, largely supplanting the native species. There are usually three annual generations in the north, and five or six in the

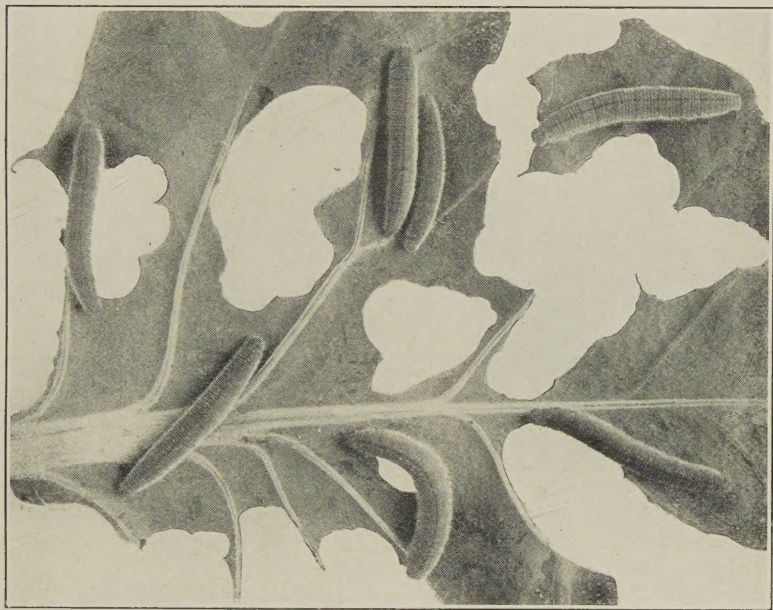


FIG. 8. Imported Cabbage Worms. Natural size.

southern states. The entire life cycle requires from three to five weeks. The larvae injure the plants by feeding on the outer leaves, often stripping them.

Description and Life History.—This is one of the first butterflies to appear in spring, and is often seen in Connecticut on warm days in March.

Egg.—Eggs are laid singly on the under side of the leaf of any available plant of the cabbage family (*Cruciferae*). They are fastened to the leaf by one end, and are about 1 mm. or one-

twenty-fifth of an inch in length, light yellow, bullet-shaped, sculptured with prominent longitudinal ridges and transverse striae. From 4 to 8 days are required for hatching.

Larva.—About 31 mm. or one and one-fourth inches long when full grown, velvety green, with a paler yellowish stripe along the back, and row of spots along each side. It moves sluggishly, and feeds ravenously on the outer or loose leaves. From ten to fourteen days are passed in this stage, which is shown in figure 8.

Pupa.—The pupa or chrysalis is about three-fourths of an inch long, at first pale green but later turning brown, marked with small black spots. It is suspended horizontally by silken threads, sometimes to its food plant, but often under fence rails, edges

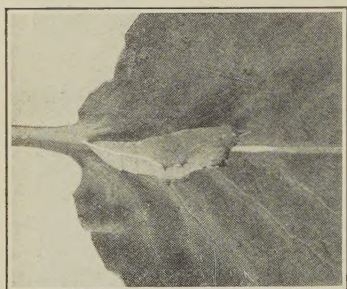


FIG. 9. Chrysalis of Imported Cabbage Butterfly. Natural size.

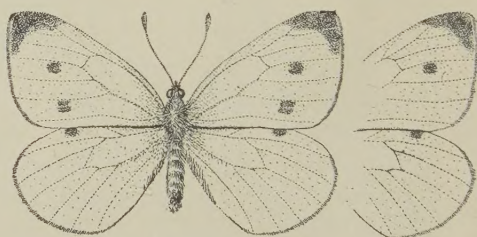


FIG. 10. Imported Cabbage Butterfly, Female at left. Natural size.

of clapboards and shingles on buildings, etc. With the early broods from seven to fourteen days is passed as a chrysalis, but the late fall brood passes the winter in this condition. Shown in figure 9.

Adult.—The butterfly has a wing-expanse of about two inches. Wings yellowish white, marked with black at the tips. The female has two circular black spots on each fore wing; the male has only one. Both sexes have a black spot on the anterior margin of the rear wing. Head, antennae and upper side of body are nearly black. Under side of body and legs are yellowish white. Shown in figure 10.

Natural Enemies.—A small four-winged fly or braconid, *Apanteles glomeratus* Linn., is the most common parasite and was

quite abundant at the Station field at Mt. Carmel in 1915. Another common parasite is a minute chalcid fly, *Pteromalus puparum* Linn. Various wasps, especially the common wasp, *Polistes pallipes* LeP., prey upon the larvae.

Control Methods.—Cabbage growers usually spray or dust their plants with lead arsenate and it is perfectly safe before the plants are headed. When nearly ready to harvest, it is advisable to dust the plants with insect powder (Pyrethrum) or some other fine dust applied with a blower or powder gun. Water heated to a temperature of 130° F. is said to kill all worms with which it comes in contact without injuring the plants.

THE POTHERB BUTTERFLY.

Pontia napi Linn.

This native species occurs in Canada and in the northeastern United States, and was formerly the common cabbage worm, but has now been almost entirely replaced in cabbage fields by the imported cabbage worm, *P. rapæ*. The larva resembles that of the imported cabbage worm but is about the same color as the cabbage leaf and usually feeds upon the under side, leaving a network of veins.

The adult does not appear as early in spring and its wings are nearly all white without the black spots. It now feeds chiefly on native vegetation.

The remedies used against the imported cabbage worm will also control this species.

THE SOUTHERN OR CHECKERED CABBAGE BUTTERFLY.

Pontia protodice Boisdv.

This butterfly is a native of the United States and is much more abundant in the southern states than in the north. Though adults are frequently seen and taken in Connecticut, we have not observed the larvae injuring cabbages here. Farther south this species was considered a serious pest of cabbage plants before the advent of the imported cabbage worm in the United States, the latter having largely replaced it as a pest.

The habits of this species and the control methods used against it are practically the same as given above for *P. rapæ*.

The egg and chrysalis are very similar to that species, but the larva differs in having two pale yellow stripes along each side.

The adult is also larger, the male resembling that of the imported cabbage worm but with additional spots on the fore wings, and the female is heavily marked with black on both front and rear wings, as shown in figure 11.



FIG. 11. The Southern or Checkered Cabbage Butterfly, Female at left. Natural size.

THE CABBAGE LOOPER OR CABBAGE PLUSIA.

Autographa brassica Riley.

As a pest, the cabbage looper ranks next to the imported cabbage worm and in certain seasons in some localities may even do greater damage. The name comes from the looping habits of its larva, due to the absence of pro-legs on the third and fourth abdominal segments, as is the case with the measuring worms.

This insect is well distributed east of the Rocky Mountains, but is far more destructive in the southern states, though it is injurious in the north. In Connecticut there are at least two broods each year, while in Florida six broods have been recorded. The larva feeds on nearly all cruciferous plants and when abundant often injures other vegetables, and in late fall occasionally attacks plants in the greenhouse.

Description and Life History.—This insect does not appear as early in the season as the imported cabbage worm, and the larva may be recognized by its smooth skin, body tapering towards the head, its light green color and looping habit. Instead

of feeding wholly on the outer leaves, the larvae often go deep into the head.

Egg.—The egg is about the size of a mustard seed, convex and pale green, and is laid singly, usually on the upper, though occasionally on the under side of the leaf.

Larva.—The full grown larva is from one to one and three-eighths inches long, pale green, indistinctly and longitudinally striped with white. It is narrowest at the head and gradually broadens toward the distal extremity. The larval period varies from two to four weeks.



FIG. 12. Cabbage Looper, *A. brassicae*, showing Adult, Larva, and Pupa Stages. Natural size. (After Chittenden, Bureau of Entomology, Bull. 33, U. S. D. A.)

Pupa.—The pupa or chrysalis is formed within a white silken cocoon on the leaves of the host plant. The duration of the pupal stage varies from one week in summer to three weeks in fall, and the last seasonal brood winters as a chrysalis.

Adult.—The adult is a noctuid moth with grayish brown forewings marked with white. It has a wing-expanse of about one and one-half inches and each fore wing is ornamented near the center with a silver dot and U-shaped mark. The rear wings are of lighter brown with darker scalloped margins.

Larva, pupa and adult moth are shown in figure 12.

Control Methods.—As a rule the methods employed against the other cabbage worms will control this species but on account of its habit of eating into the heads arsenical poisons should not be used on headed plants. The cabbage looper is apparently not as susceptible to dry powders as is the imported cabbage worm.

THE CABBAGE APHIS OR PLANT LOUSE.

Aphis brassicae Linn.

The cabbage aphis is another serious pest brought to this country from Europe, probably on cabbage, and has since spread

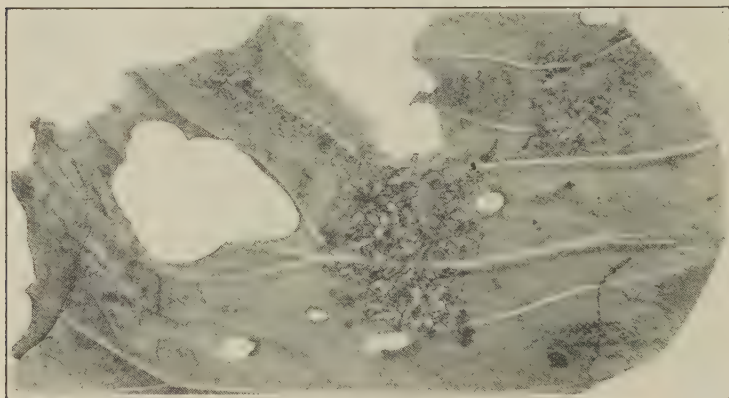


FIG. 13. Cabbage Aphis on Leaf. Natural size.

rapidly throughout the United States. It is present and usually abundant every year in Connecticut, though affected considerably by atmospheric conditions. It is usually found on the under side of the leaves where it sucks the sap, often causing great damage when abundant. It is even a more serious pest farther south.

Description and Life History.—This insect appears here in June, and like most plant lice, several generations of winged and wingless females are produced which bring forth living young. On the approach of cold weather a true sexual generation is produced and the females lay eggs to carry the species through the winter.

The young nymph is pale green with black legs and antennae. The mature forms are yellowish green with black head and eyes

and dark cornicles or honey tubes. Except for the wings, the winged and wingless forms resemble each other.

Instead of occurring individually on the leaves as is the case with some plant lice, the cabbage aphid usually occurs in large colonies, often covering considerable leaf surface on badly infested plants. The wax exudation gives the colony a bluish bloom and interferes somewhat with the application of insecticides. This insect is shown in figure 13.

Natural Enemies.—Lady beetles, chrysopid, and syrphid larvae, and many minute, four-winged parasitic flies help to hold the cabbage aphid in check.

Control Methods.—The nicotine solution known as "black leaf 40," one teaspoonful in a gallon of water, with a little soap added, and sprayed upon the plants, proved effective and satisfactory in destroying this aphid in our experiments at Mt. Carmel. On account of the wax secretion, it is necessary to add the soap. Any mixture of tobacco and laundry or whale-oil soap, or even the soap alone, will probably prove successful if it contains at least one pound of soap to eight gallons of water. In any attempt to control sucking insects it is imperative that the mixture come in direct contact with their bodies. Even a forceful stream of water from a hose has often been used to advantage in disposing of aphids on cabbage plants and may also prove a satisfactory method of getting rid of some of the other cabbage insects.

THE CABBAGE PLUTELLA.

Plutella maculipennis Curt.

Though not usually a serious pest, at times the cabbage plutella causes considerable damage to the cabbage crop by eating small holes through the outer leaves. The larvae are quite small and may easily be mistaken for young cabbage worms: in fact, most growers regard them as the young larvae of some other insect, and the identity of the cabbage plutella is thus often overlooked.

Description and Life History.—The larvae are generally more abundant in a dry season than in a wet one, and there are two or three annual generations in this part of the country, but we have not studied its life history in Connecticut.

Egg.—The egg is white, very small and generally attached to the leaves.

Larva.—Pale green and only about one-fourth of an inch long when full grown. Very active, and when disturbed wriggles and drops to the ground.

Pupa.—Enclosed in a whitish open-work net, usually attached to the leaves. It hibernates in this form.

Adult.—A small tineid moth having a wing-expanse of five-eighths of an inch, the general color being ash-gray with light clay-yellow rear margins on the fore wings.

Control Methods.—The measures for controlling the imported cabbage worm will also hold this insect in check.

THE ZEBRA CATERPILLAR.

Mamestra picta Harr.

The zebra caterpillar is a very common pest in the garden, attacking nearly all kinds of vegetables as well as flowering plants, and is the first insect recorded in this country as feeding on the beet. As a rule, in Connecticut its damage is not serious or widespread.

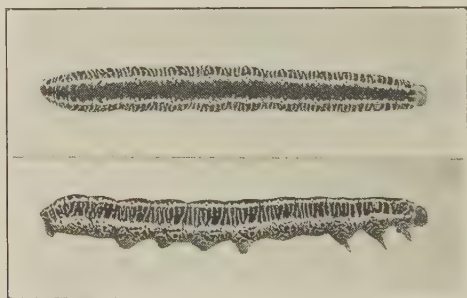


FIG. 14. Zebra Caterpillar, showing dorsal and lateral views. Natural size.

Description and Life History.—A smooth caterpillar about two inches long when full-grown, and black or dark brown strikingly marked with yellow, as shown in figure 14. Its head is orange or reddish yellow. The young caterpillars feed in clusters and may easily be destroyed by hand.

Adult.—The adult is a noctuid moth, having a wing-expanse of one and one-half inches, appearing in June. The fore wings

and thorax are reddish brown without prominent markings. The rear wings are nearly white, margined with light brown.

Control Methods.—Spraying with arsenical poisons will control this insect.

The imported cabbage web-worm, *Hellula undalis* Fabr., and the cross-striped cabbage worm, *Evergestis rimosalis* Guen., both injure cabbage plants in the southern states but are not known to occur in Connecticut. The remedies used against the other cabbage worms will control them.

THE HARLEQUIN CABBAGE BUG.

Murgantia histrionica Hahn.

The Harlequin cabbage bug is a native of Mexico and Central America and migrated into Texas about 1864 and has gradually spread toward the northeast. It is a serious cabbage pest in the southern states and even as far north as southern New Jersey. In 1894 it was quite abundant on Long Island but Mr. F. A. Sirrine writes that it has not been common there since; and that he has not seen a specimen for several years. The only specimen thus far recorded from Connecticut is now in the Station Collection, and was collected at Meriden, July 4, 1910, by Mr. Harry L. Johnson. It will probably never cause serious damage in Connecticut but it is mentioned here so that Connecticut growers may recognize it if it appears in the State. This insect is also called "Calico Back," "Calico Bug," "Terrapin Bug," and "Fire-Bug." It injures the plants by sucking out the sap.

Description and Life History.—The eggs are barrel-shaped and are usually deposited in two rows, with one end of each egg fastened to the under side of the leaf. They are green at first but soon change to white with black markings. Only two or three days are required for hatching in the southern states.

The nymphs are generally oval and somewhat flattened. The young are glossy yellow, but as they develop become black with reddish yellow markings. In about two weeks they become mature.

The adult resembles the nymph but has wings, and is black and orange-yellow and marked as shown in figure 15. In the

northern states the adults hibernate in rubbish where they can find protection, but in the south they may be found feeding upon cabbage plants at any time during the winter.

Control Methods.—This “bug” is especially difficult to control. In places where it hibernates all rubbish should be removed from the field in the fall, that would furnish a place of shelter. Hand picking in the early spring is also effective.

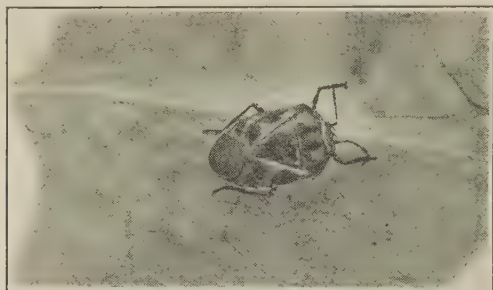


FIG. 15. Harlequin Cabbage Bug. Twice natural size.

The cabbage flea beetle, *Phyllotreta vittata* Fabr., which occurs in Connecticut, and the cabbage curculio, *Ceutorhynchus rapæ* Gyll., which has not been recorded from the state, are both common in New Jersey and feed on cabbage and allied plants. If they should appear in destructive numbers in Connecticut, a spray of lead arsenate will probably serve to control both insects.

CUT-WORMS.

At the Station farm in Mt. Carmel in 1915 considerable damage to cabbage plants was caused by cut-worms. Many plants were cut off just above the surface of the ground as shown in figure 16, only a few days after the plants were set.

Ordinarily cut-worms feed on grasses and are not seriously injurious, but when the field in which they are located is cultivated, in the absence of their natural food they attack the cultivated crop. There are several species of cut-worms causing similar damage, but the most injury is done by the common ones and the remedy is practically the same for all species. These cut-worms are the larvae of moths belonging to the family Noctuidæ. The majority collected this season were the so-called “well-marked cut-worm,” *Noctua clandestina* Harris.

The "worms" feed at night, usually cutting off the stem of the plant just above the ground, and go into the ground to hide during the day. When full grown, in the late spring, they are of a dark brown and blackish color, with stripes running longitudinally. Usually there is only one generation each year.

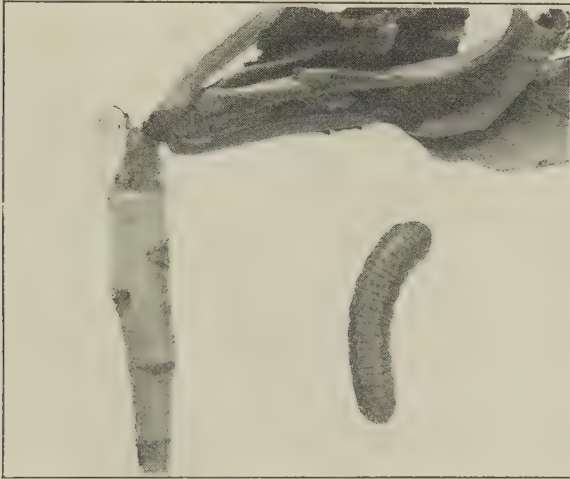


FIG. 16. Cut-worm and severed Cabbage Plant.
Natural size.

The most effective control method used this season was in the form of a sweetened poisoned bran mash. The formula used was that recommended for the controlling of grasshoppers in Kansas, and is as follows:

Bran mash	$\frac{1}{2}$ bushel
Paris green	1 pound
Lemons	3
Molasses	2 quarts
Water	$3\frac{1}{2}$ gallons

Mix the Paris green (dry) with the bran thoroughly. Squeeze the juice of the lemons into the water and cut up pulp and rind into fine pieces and mix together. Then pour in the molasses and stir. This mixture is then added slowly to the poisoned bran mash and when complete is rather dry and easy to handle. This should be applied by scattering it broadcast in the late

afternoon, if possible before the plants are set, so that it will be moist when the "worms" start to feed in the early evening. Experiments have shown that the use of lemons was 40 per cent. more effective than the use of oranges. Paris green was also found to be more effective than arsenate of lead.

Early spring plowing and harrowing will tend to greatly reduce the number of these "worms." Trap crops are sometimes used. "Trap crops are those which are planted as a bait or lure to attract the early insects so that they may be destroyed upon them before the crop to be protected is available."

WIRE-WORMS.

Wire-worms are hard, shiny, slender, light brown larvae about three-quarters to one inch in length, which often bore into the stems and roots of many field and garden crops. They belong to the family Elateridae, commonly known as "click-beetles" or "snapping beetles," and generally breed in sod ground. These worms usually feed on the roots of grasses and native plants and are seldom noticed. When such ground is cultivated and planted with vegetables, the worms do not have the grass roots on which to feed and at once attack the cultivated crop. As it takes from three to five years for these insects to complete their life cycle, they are a difficult pest to control. The past season there were a great many wire-worms present at Wethersfield, Connecticut, and entirely ruined a crop of early cabbage at Fair View Farm, belonging to Mr. W. G. Griswold. This form of injury is shown in figure 17. At the Station farm at Mt. Carmel they did considerable damage to lettuce planted on new ground. There is no solution that can be applied strong enough to kill the worms without injuring the plants. Rotation of crops is recommended and also the placing of a catch-crop.

CABBAGE SNAKES.

There are no true snakes which infest cabbages, but the name "cabbage snake" is applied to a species of *Mermis* which is really a long, slender, cylindrical worm, commonly known as a "hair worm" or "hair snake." These worms are parasitic in the bodies of a number of insects and are often found coiled up in the soil. Occasionally one is found in a cabbage head, and

is made the subject of a startling newspaper story. Such worms will neither injure cabbages nor persons eating cabbages.



FIG. 17. Wire-worms and Cabbage Plants injured by them.
Natural size.

One of the “thousand legs” (*Geophilus bipuncticeps*) is also found in the heads of cabbages and is also called a “cabbage snake.” It is a blind, earth-inhabiting animal, is neither a snake nor an insect, and like the “hair worm” is not harmful to cabbages or human beings.

. CULTURAL PRACTICES.

Truck crops in general are peculiarly susceptible to insect attack, there being a total loss of 20 per cent. of their total value due to the ravages of insects. As many insects feed only on one crop, it is absolutely essential that the crops be rotated. For example, the cabbage root maggot hibernates in or near the field where cabbage has been grown, and if that same field is planted to cabbage the next spring, food for this insect will be abundant. The result will be a probable increase of the pest. Crops such as cabbage, radish, cauliflower, etc., which are closely related, should be avoided in crop rotation as insects generally feed on closely related plants.

Cabbage stumps, leaves, etc., should not be allowed to remain in the rows, but should be removed from the field and destroyed or plowed under as soon as possible after the crop is harvested. If this is not done, it leaves a hibernating place for insects.

Late fall plowing destroys a great many insects while hibernating. Different insects pass the winter in different stages of development. Cut-worms pass the winter in the soil as larvae, while click-beetles hibernate as newly-formed beetles. Cut-worms may be greatly reduced in numbers by early spring plowing and harrowing, which will crush them or starve them out before the crop is planted.

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CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN 195, JULY, 1917

ENTOMOLOGICAL SERIES, No. 24.

INSECTS INJURING STORED FOOD PRODUCTS
IN CONNECTICUT

By W. E. BRITTON, *State Entomologist.*

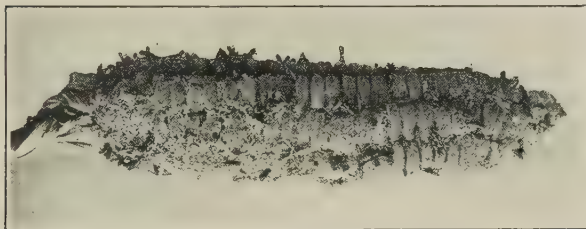


FIGURE 1. Ear of corn injured by the European grain moth, half natural size.

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Insects Injuring Stored Food Products in Connecticut.

By W. E. BRITTON, State Entomologist.

The importance of growing more food for the people of this country cannot be over-emphasized, and the various efforts along this line and the publications giving information regarding methods are all praiseworthy. Nevertheless, it is perhaps equally important to conserve the food supplies already grown and stored. It has been estimated that insects take an annual toll of about five per cent of the value of the stored food products, amounting to \$200,000,000.00 each year, in the United States. Most of this loss is wholly preventable if attention is given the matter at the right time, and there is no time when control methods can be enforced with greater profit to the owner, or with greater benefit to our country and to mankind than the present.

The object of this bulletin is to place before the people of Connecticut a brief account of the principal insects attacking and injuring stored grains and food products in the state, and to suggest methods of controlling them. The figures are included for the purpose of illustrating the text and of giving an idea of the general appearance of the insects.

These insects belong in two large natural groups: the Beetles (Coleoptera) and the Moths (Lepidoptera). The principal features of each are given to enable the reader to identify the species, but as control measures are similar for all, information on this point is given in a separate chapter on page 16 of this bulletin.

THE GRAIN BEETLES.

THE COMMON MEAL WORM, *Tenebrio molitor* Linn.

In and around the bottoms of bins and barrels where corn meal, flour, or other cereals are stored, one often finds yellow larvae about an inch in length and resembling wire worms. These feed upon the meal and are called meal worms.

The adult is a shining, black or dark brown, beetle, somewhat more than half an inch in length, with thorax rather finely punctured and wing-covers longitudinally striated or grooved. The

beetle lays its white eggs in the meal, usually in masses, with a juice or sticky material which causes the meal to adhere to the eggs. The eggs hatch in about two weeks and the larvae feed upon the meal for three months or longer before pupating. The pupal stage requires about two weeks, and normally there seems



FIGURE 2. Common meal worm, adult and larva, natural size.

to be but one generation each year. The adults mostly emerge in the spring, but where the meal is stored in the house, or in a heated building, they may appear at any time of the year. This insect is shown in figure 2.

THE DARKER MEAL WORM, *Tenebrio obscurus* Fabr.

This insect is much like the preceding except that the larvae are darker in color and the adult beetles are dull instead of shiny. The life history and injuries are similar and both often occur in the same place.

The treatment is also the same for both species, viz.; fumigating with carbon disulphide or heating the meal in an oven for a short time.

THE CADELLE, *Tenebrioides mauritanicus* Linn.

The larva of this beetle is dirty-white, with head, prothorax and tip of abdomen dark brown, and when fully grown it measures about three-fourths of an inch in length. It has the habit of tunneling into wood to make its cocoon, at least when soft pine is available. The pupa stage evidently lasts three or four weeks.

The adult beetle is brown and shiny, and about three-eighths of an inch long. It lays white eggs which are a trifle over a millimeter long and one-fourth as thick.

There is a single generation annually, and the cadelle feeds on various kinds of stored foods and plant products and is also partially predaceous, as Chittenden* states that both larvae and adults attack and destroy other grain insects which they encounter. Nevertheless, the cadelle is capable of causing con-



FIGURE 3. Cadelle, adult and larva, twice natural size.

siderable injury and the treatment is the same as for the other meal worms. The larvae of the cadelle have been reported from many unexpected places, such as in sugar, in bottles of milk, in powdered hellebore, and boring through the parchment paper of jars of jams and jellies. In some of these places they probably occurred accidentally. Larva and adult are shown in figure 3.

THE PEA WEEVIL, *Bruchus pisorum* Linn.

The adult beetle is about one-fifth of an inch long, and the wing covers are marked with small black and white spots. It lays eggs singly on the outside of the green pods in the field, and the larva tunnels through the pods and into one of the green peas. The insect does not mature until the peas have ripened and have been harvested and placed in storage. Then it is common to find a single round hole in a pea where the adult has emerged. Sometimes nearly every pea has a hole in it, and many larvae are unquestionably cooked and eaten in green peas ;

* F. H. Chittenden, Farmer's Bulletin No. 45, U. S. Department of Agriculture, page 19, 1896.

but the insect does not go on breeding in dry stored peas, there being only one brood each year.

The pea weevil is more serious in the Middle Atlantic than in the Northern States, but it is present in Connecticut. In the Southern States it is claimed that late planting brings compara-



FIGURE 4. Pea weevil, adult beetle, four times enlarged.

tive immunity from attack but in the writer's experience late planted peas seldom produce a satisfactory crop here. Hence it is better to treat the seed soon after harvesting, and to make allowance in planting for a certain percentage of injured seed. This insect is shown in figure 4.

THE COMMON BEAN WEEVIL, *Bruchus obtectus* Say.

This is probably the greatest enemy of beans in Connecticut, and though in size somewhat smaller than the pea weevil and

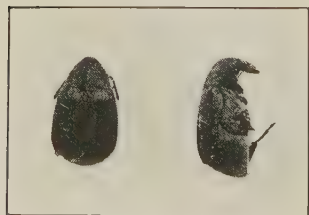


FIGURE 5. Common bean weevil. Adult beetles, four times enlarged.



FIGURE 6. Infested cow peas, showing eggs and exit holes of bean weevil, natural size.

resembling it in color and markings, it differs from it by continuing to breed in the dry, stored seed. There are six generations annually in the District of Columbia, and a smaller number in the northern states. Stored beans are often entirely destroyed, or at least rendered unfit for planting, or as food for man or beast. The beans often have several holes in each where the adults have emerged, and as many as 28 have been found in a single seed. Severely weeviled beans are almost useless for planting, but the good seed may be separated from the infested seed by throwing into water. The injured seed will float and may be discarded. This beetle and its work are shown in figures 5 and 6.

THE FOUR-SPOTTED BEAN WEEVIL, *Bruchus quadrimaculatus* Fabr.

This species is somewhat more slender than the preceding and has different markings. Its habits and life history are similar and the same control methods may be practiced.

THE DRUG STORE BEETLE, *Sitodrepa panicea* Linn.

Of all the insects attacking stored food products, perhaps none is more cosmopolitan or feeds upon a greater number of different kinds than the drug store beetle. It is a common pest of all kinds of stored vegetable foods and may be found in breakfast



FIGURE 7. Drug store beetle. Adults, four times enlarged.

foods, or the dried roots, stems, bark, and seed capsules commonly called spices. It feeds also on the parts of plants used as drugs, often eating those which are bitter and poisonous to man. It has been recorded as attacking forty-five different drugs. It is now distributed throughout the civilized world, and four or

five generations may occur in a year, especially in a heated building.

The beetle is about one-tenth of an inch in length, covered with a silky pubescence, and reddish-brown in color. The wing-covers are longitudinally striated and the antennae terminate in three long segments forming the so-called "club." The larvae are white, with dark mouth parts, and assume a curved attitude when at work in their burrows. The adult is shown in figure 7.

THE CONFUSED FLOUR BEETLE, *Tribolium confusum* Duv. and
THE RUST-RED FLOUR BEETLE, *Tribolium ferrugineum* Fabr.

The confused flour beetle has been known to occur in this country for nearly twenty-five years and has caused injury throughout the land. It attacks seeds, stored cereals and other starchy foods and drugs, and is a pest in flour and grain mills.

The adult is a flattened brown beetle, less than a sixth of an inch in length. There may be as many as four generations annually in a heated storehouse.

The rust red flour beetle closely resembles the preceding, but is not nearly as common in Connecticut. It is a pest in the Southern States and is often shipped north in rice or other starchy food products.

THE SAW-TOOTHED GRAIN BEETLE, *Silvanus surinamensis* Linn.

One of the most common beetles in grain and stored food products is the saw-toothed grain beetle. It is less than an eighth of an inch long, flattened, grooved longitudinally, with teeth-



FIGURE 8. Saw-toothed grain beetle, four times enlarged.

like projections on the sides of the thorax, and brown in color. The larva is white, extremely active, and makes its pupa case on some convenient surface by joining together particles of the infested material with some adhesive substance which it secretes.

There are probably four or five generations each year, and the beetles eat through paper bags and pasteboard boxes to reach foodstuffs inside. Though perhaps preferring farinaceous foods, this beetle often infests fruits and almost all kinds of stored food products. This beetle and its injury to corn are shown in figures 8 and 9.



FIGURE 9. Peruvian seed corn injured by saw-toothed grain beetle, reduced one-half.

A flat, smooth, reddish-brown beetle, still smaller than the preceding, is occasionally found infesting wheat bran or other cereals. This is *Lamophlaeus pusillus* Schr., one of the minor pests but nevertheless capable of causing much injury.

THE GRANARY WEEVIL, *Calandra granaria* Linn.

Both this weevil and the following belong to the family Calandridae or snout beetles. The adult is a shiny reddish-brown snout beetle nearly an eighth of an inch in length, with a long proboscis. The larva is a legless grub. Both adult and larva feed upon the kernels of the grain. There are four or five generations each year in the vicinity of Washington, D. C., and more farther south. It attacks and injures maize and all of the small grains.

THE RICE WEEVIL, *Calandra oryzae* Linn.

This species resembles the preceding except that it is dull brown instead of shining, and the thorax is more densely pitted. There are four more or less distinct red spots on the wing-covers. This insect is often found in the field and takes its name from

the rice which it infests. Its habits and life history are otherwise similar to the preceding. It is shown in figure 10.



FIGURE 10. Rice weevil. Adults four times enlarged.

THE FLOUR AND MEAL MOTHS.

THE INDIAN MEAL MOTH, *Plodia interpunctella* Hubn.

Considerable damage is done each year in mills, granaries, seed warehouses, etc., by the Indian meal moth, which is also a common pest of the household, as it attacks nearly all kinds of



FIGURE 11. Kernels of corn injured by the Indian meal moth. Natural size.

vegetable food products. Each year some food material infested by this insect is brought to the writer's attention. In 1905 some large seed warehouses near New Haven were found infested, and one room was fumigated with hydrocyanic acid gas. This treatment killed the larvae crawling about, and those at work near the outside of the bags, and at first seemed to be effective. Later, however, living larvae appeared from inside, showing that the gas did not penetrate far into the mass of grain.

The larvae web together the grain and flour, especially around the outside. One 100-pound bag of corn was emptied and seven pounds adhered to the bag. The kernels were eaten at the embryo, and are shown in figure 11.

The eggs are small, white, and laid singly or in groups, and each female may lay as many as 350. The larva is whitish, and spins a silk thread wherever it feeds and travels, and the web

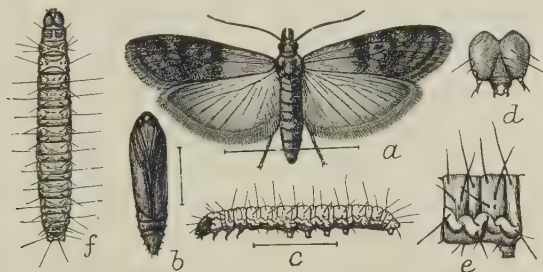


FIGURE 12. Indian meal moth. *a*, adult; *b*, pupa; *c*, larva, side view; *d*, head of larva, front view; *e*, first abdominal segment of larva; *f*, larva, dorsal view—all greatly enlarged. (After Chittenden, Bur. of Ent., U. S. Dept. of Agriculture.)

holds together the particles of food material. Pupation takes place in a silken cocoon-like web from which the moths emerge. From four to five weeks only are required for a generation to develop. In a heated building this insect will breed throughout the year.

The adult is a small moth having a wing-spread of about five-eighths of an inch; forewings whitish at base with distal half reddish-brown, as shown in figure 12.

THE MEDITERRANEAN FLOUR MOTH, *Ephestia kuehniella* Zell.

This insect is regarded by Chittenden as the most important of all the species infesting flour and grain mills. It has been

reared from flour in New Haven and has been taken at Branford. In life history and injury the Mediterranean flour moth resembles the Indian meal moth, and in heated buildings five or six broods may occur each year. The moth is shown in figure 13. It is

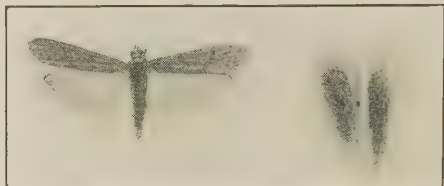


FIGURE 13. Mediterranean flour moth and cocoons, slightly enlarged.

larger than the Indian meal moth and has a wing-spread of about an inch. The forewings are dull lead-gray, crossed by zigzag darker lines or bands. Not only does this insect injure flour and grain but also feeds upon almost any kind of stored vegetable food products.

THE MEAL SNOUT MOTH, *Pyralis farinalis* Linn.

This insect infests flour, meal, and other stored food products, though not as serious a pest as the Indian meal moth or the Mediterranean flour moth.

The larvae have the habit of constructing long tubes by binding together with silk small particles of the meal or food material. In these tubes the larvae live and hide until fully grown when



FIGURE 14. Meal snout moth. Natural size.

they leave the tubes and spin their cocoons, usually in or just outside of the infested material. There are probably three or four generations each year, though further studies are needed in this latitude to determine this point.

The adult has a wing-spread of about an inch, is light brown, with thorax, base and apex of fore wings darker brown, and with whitish wavy lines crossing front and rear wings, as shown in figure 14.

THE GRAIN MOTHS.

THE ANGOUMOIS GRAIN MOTH, *Sitotroga cerealella* Oliv.

This destructive insect was known in France nearly two hundred years ago, and was somehow brought to this country in the early colonial days, and became established in North Carolina and Virginia. Since then it has spread northward to Massachusetts, New York and Michigan and throughout the southern states, where it does much damage. The writer first noticed it in Connecticut nearly twenty years ago, and has run across it a number of times since. It is primarily a pest of stored grains, especially corn on the ear, which if infested soon appears as in

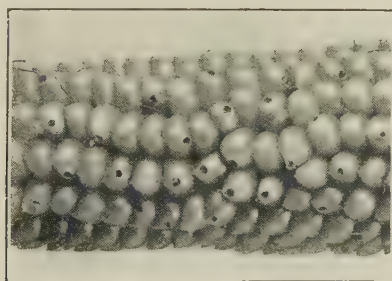


FIGURE 15. Pop corn showing exit holes of Angoumois grain moth.
Natural size.

figure 15. The emerging moths leave small circular holes in the kernels. Infested grain is injured not only for seed, but also for feeding purposes; as it has been estimated that it loses within six months 40 per cent of its weight and 75 per cent of the starchy matter. The moth lays whitish eggs on the kernels of corn, and they soon turn to a pale reddish color and hatch in five or six days. Two or more larvae may occupy a single kernel of maize, though only one occurs in a grain of wheat. The adult is a light, grayish-brown moth, having a wing-expanse of about half an inch, somewhat resembling a clothes moth. Out of doors in the southern states there are at least four broods

annually and the larva passes the winter in kernels of grain. In this climate it breeds only in stored grain, and in heated buildings this goes on continuously, there probably being five or six generations, depending upon the temperature.

THE EUROPEAN GRAIN MOTH, *Tinea granella* Linn.

Compared with the Angoumois grain moth this moth is of secondary importance, and seems to be not especially destructive in the United States. It infests all kinds of cereals, and as each larva may pass from one kernel into another, webbing them together until twenty or thirty grains are spoiled, it is apparent that considerable injury must result.



FIGURE 16. European grain moth. Three times enlarged.

This moth was first found in Connecticut, in 1906,* in a seed warehouse in Milford. It is now distributed throughout the northern states.

The adult is a slender moth with a wing-spread of half an inch, creamy white mottled with brown, and is shown in figure 16. Its work is shown in figure 1.

OTHER INSECTS OCCASIONALLY ATTACKING FOODS.

The large cabinet beetle, *Trogoderma tarsale* Melsh., frequently injures seeds and is shown in figure 17. The small cabinet beetle, *Anthrenus verbasci* Linn., and the black carpet beetle, *Attagenus piceus* Oliv., occasionally attack and injure food products, though the latter is a more important pest of clothing.

* Report of this Station for 1906, page 305.

The larder or bacon beetle, *Dermestes lardarius* Linn., the red-legged ham beetle, *Necrobia rufipes* Fabr., and certain species of mites of the genus *Tyroglyphus* sometimes injure dried meats, cheese, dried fruits, cereals, etc. The cigarette beetle, *Lasioderma serricorne* Fabr., though primarily a pest of tobacco, feeds

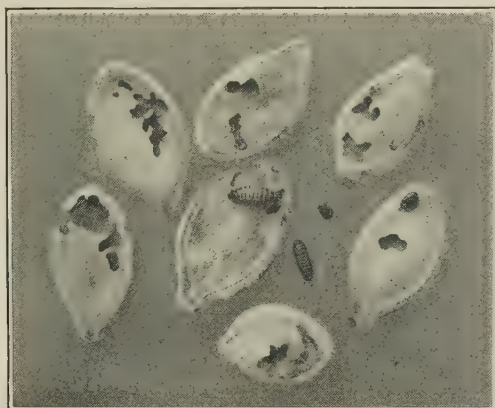


FIGURE 17. Seeds injured by the large cabinet beetle. Natural size.

upon the spices, rice, figs and many other food products. Then the cheese skipper, *Piophilidae casei* Linn., which occurs everywhere, often attacks cheese and the larvae may be found tunneling in it. Cheese should be kept covered and should be examined every day in warm weather. Hams and other kinds of meat are infested only in certain portions which can be cut off and the remainder used for food.

A species of book-lice, *Troctes divinatorius* Müll. (order Corrodentia), was found eating corn at the Station in 1900. The sample was stored in a ground glass-stoppered jar. The outer surface of the kernels was wholly eaten off, so as to render the variety wholly unrecognizable.

Cockroaches and ants are also frequently injurious in pantries and storehouses. The former are usually susceptible to the influence of powdered borax, and ants can usually be driven away by scattering naphthalene flakes about on the floor and shelves, especially where the ants have their runways.

The other insects mentioned in this chapter without control methods may be killed by heat or by fumigation.

CONTROL METHODS.

The chief methods for preventing damage by the insects mentioned in the foregoing pages are: the use of high and low temperature, air-slaked lime, pest proof packages and fumigation.

TEMPERATURE.

Temperature is recognized as an important factor in insect development, and often determines in a measure the number of annual generations of certain species. Extremes in temperature are sometimes employed for the control of insects.

HEAT.

It has long been known that heat will kill insects, and one of the simplest methods of destroying them in small packages of flour or other food products is to heat it in the oven for an hour or so. Following this idea Professor George A. Dean started some experiments in Kansas in 1910 to determine the fatal high temperatures for certain grain-infesting insects, and found that few insects can withstand a temperature of from 118°-125° F. for any length of time. In a mill there are accumulations of meal and flour on the floor, beams, machinery, and in the corners everywhere in which insects can breed. To keep a mill free from this accumulation and absolutely clean is almost an impossibility. By the use of heat, however, the insects can be killed from time to time without serious inconvenience, without shutting down the mill, and without great expense. It requires extra steam pipes sufficient to raise the temperature to about 120° F., and to keep it there for a period of five or six hours to allow the heat to penetrate the bins and bags of grain. Professor Dean has published three papers on this subject,* and any one interested should write to him for further advice.

Any grain or seeds which are intended for planting should not be heated to a point much greater than 130° F. as there is danger of injuring the vitality, which with some seeds ceases if the temperature approaches 150° F.

Any product to be used for food will not be injured by this

* Journal of Economic Entomology, Vol. IV, page 142, 1911; Vol. VI, page 40, 1913. Kansas Agricultural Experiment Station, Bull. 189, July, 1913.

heating method and even the eggs and larvae, as well as the adult insects, are killed by it.

COLD.

A low temperature is not so frequently used for destroying insects, yet it has been known for a long time that insect development is arrested or suspended altogether in cold storage.

Mr. J. A. Manter* of Storrs, Conn., states that the bean weevil will not breed in cold storage and suggests that beans be stored in unheated buildings. This idea may be carried out in practice with certain other stored food insects but the exact temperatures have not yet been determined for all species.

AIR SLAKED LIME.

A very simple and promising treatment to prevent weevil injury to peas, beans, cow peas and possibly to other kinds of

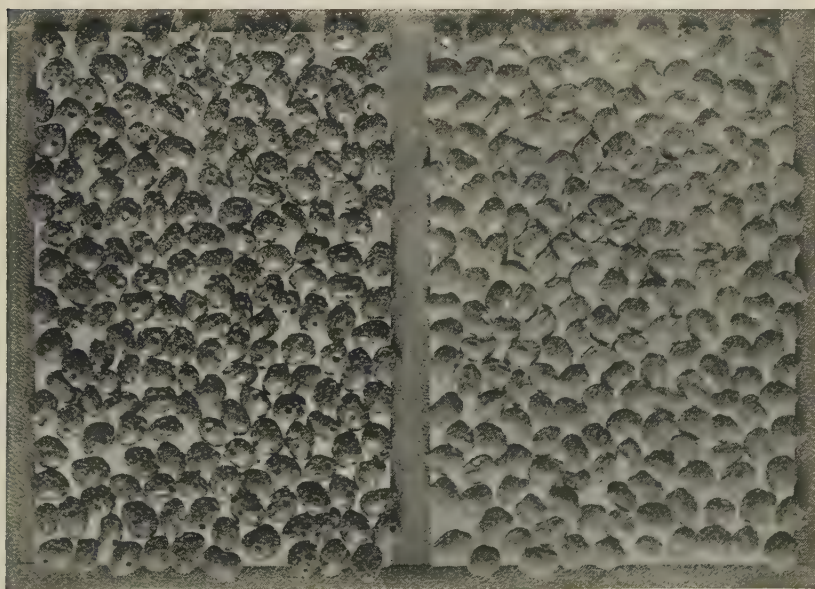


FIGURE 18. Effect of air slaked lime. Treated seeds at right. (After Metcalf, North Carolina Agricultural Experiment Station. Jour. Econ. Ent., Vol. 10, plate 3, fig. 2.)

* Journal of Economic Entomology, Vol. X, page 193, 1917.

seeds has recently been discovered by Mr. Z. P. Metcalf* of the North Carolina Station. This consists of applying air-slaked lime to the seeds, using one part by weight of lime to two parts of seeds when placing the crop in storage. For small quantities, say less than a half peck, Professor Metcalf advises the writer in a letter that four parts of lime should be used to one part of seeds; for quantities between a half peck and three bushels, use equal amounts of lime and seeds. The quantity of seeds to be stored thus influences the effectiveness of the treatment and necessitates greater proportions of lime for small quantities. In time this method may be found applicable to other kinds of seeds and against other insects. It has the advantage of being harmless to seeds and to the operator, as well as being convenient to procure and relatively inexpensive. Professor Metcalf is now completing further tests of this material. Figure 18 shows untreated seeds and those treated with lime.

PEST-PROOF PACKAGES.

Materials sealed in glass or metal containers are usually safe against insects as long as they remain unopened. We have a number of records showing that the smaller beetles, like the saw-toothed grain beetle, will enter poorly stoppered glass bottles and jars and even tin-stoppered cans. The material is of course often infested before placing in the containers.

Mr. William B. Parker of the U. S. Bureau of Entomology has made investigations and suggests† a sealed paper carton for packing cereals which are to be placed upon the market. While this may prevent infestation in stores and warehouses, in the household many opened packages often attract insects, and if stored for a long time no paper package is insect-proof. Hence other methods must be resorted to, especially in dwelling houses, to keep the foodstuffs free from insect attack.

FUMIGATION.

Fumigation has long been practiced to kill insects in seeds and food substances. For this purpose two materials are commonly used, viz., carbon disulphide and hydrocyanic acid gas.

* Journal of Economic Entomology, Vol. X, page 74, 1917.

† Bulletin 15, U. S. Department of Agriculture, 1913.

CARBON DISULPHIDE (BISULPHIDE).

This is a colorless, ill-odored liquid which volatilizes at air temperatures, more readily in warm weather, and the fumes are deadly to all forms of insect life. Carbon disulphide may be purchased in pound bottles from any wholesale druggist, and as it is inflammable when the fumes are mixed with air, it should not be used by any one smoking, or at night with oil or gas lights near. As the fumes are heavier than air the liquid should be placed on top, rather than at the bottom of the grain, seeds or material to be treated. It should also be placed in a shallow dish to facilitate volatilization. The quantities used are about one pound to each 40 bushels of seeds, or to each 100 cubic feet of space. In a tight barrel containing grain or seeds, about one-half cupful of the liquid should be placed in a saucer on top of the seeds, the barrel covered tightly and allowed to remain all day or longer. For smaller receptacles, use proportionate quantities of the liquid. Carbon disulphide is more convenient, less dangerous to the operator, and its fumes penetrate better than hydrocyanic acid gas. A recent bulletin by Dr. Hinds* contains much information about carbon disulphide and may be obtained by applying to the U. S. Department of Agriculture, Washington, D. C.

HYDROCYANIC ACID GAS.

This is a deadly poisonous gas generated by putting together cyanide, sulphuric acid and water. Potassium cyanide was formerly recommended, but sodium cyanide is now the cyanide of commerce and is effective. The quantities for 100 cubic feet of space are as follows:—

Sodium cyanide	1 oz.
Commercial sulphuric acid	2 fluid ozs.
Water	4 " "

If a room is to be fumigated its cubic space must be ascertained and the chemicals carefully weighed or measured. It must be made reasonably tight, and provision must be made for opening from the outside at least one window or door, besides the exit. The generating jar may be earthen or stoneware but never

* Farmers' Bulletin 799, U. S. Department of Agriculture, June, 1917.

metal. The acid may be diluted with the water, the cyanide placed in a paper or cheesecloth bag, and when all is ready the operator should drop the bag into the jar and with bated breath retire at once and close and lock the door. One full inhalation of this gas will drop a man, and no carelessness should be permitted. The house or room should be exposed for at least two hours and may remain closed over night or over Sunday. The fumes do not penetrate as well as those of carbon disulphide.

Recently Mr. E. R. Sasscer of the U. S. Department of Agriculture has devised an apparatus for fumigating cotton bales, bags of seeds, etc. By removing the air and forcing the gas into a partial vacuum thus created, most insects are killed with a half hour exposure.* On account of the danger, trouble of generating, etc., the average farmer and householder will seldom use hydrocyanic acid gas and will find carbon disulphide or heat sufficient to meet his needs.

SUMMARY.

Much damage results each year in Connecticut to cereals and other stored food products from the attacks of insects. This injury has been estimated at five per cent of the total value of the products, or \$200,000,000.00 each year for the United States, and is wholly preventable.

The insects are chiefly beetles (Coleoptera) and moths (Lepidoptera). The former include the meal worms, cadelle, pea and bean weevils, drug store beetle, confused flour beetle, rust-red flour beetle, saw-toothed grain beetle, granary weevil, rice weevil, large and small cabinet beetles, black carpet beetle, larder beetle, red-legged ham beetle, and cigarette beetle. The latter include the Indian meal moth, Mediterranean flour moth, meal snout moth, Angoumois grain moth, and European grain moth. Other insects like the cheese skipper (a fly), a book louse, ants, cockroaches, and even mites occasionally cause damage.

The most important of these pests are described briefly in the preceding pages.

* Bulletin 186, U. S. Department of Agriculture, 1915.

Most of these insects may be destroyed by raising the temperature to a point between 120° and 130° F. for five or six hours. The vitality of seeds is endangered if the heat approaches 150° F. but the material would not be injured for food.

Food kept in cold storage will not be injured by insects.

Various pest proof packages have been devised, but food often becomes infested in them, and no package is pest proof after the seal has been broken.

Air-slaked lime applied to seeds when placed in storage will prevent most of the damage caused by the pea and bean weevils. The proportions are as follows: For small quantities, say less than a half peck, four parts of lime to one part of seeds; between a half peck and three bushels, equal parts of lime and seeds; for greater quantities, one part of lime to two parts of seed.

Fumigating with carbon disulphide, using a half cupful to a barrel, will rid the material of insect life. This liquid should be placed on top of the infested material, and should not be used near a fire as it is inflammable. The container should be tightly covered for twenty-four hours or longer.

Hydrocyanic acid gas may also be used but is not advised except in particular cases, as it is deadly to breathe and does not penetrate masses of flour and grain readily. Seeds and food materials if thoroughly aired are not injured by carbon disulphide or hydrocyanic acid gas, either for food or for planting.

For more detailed information on this subject the reader should refer to the pages of this bulletin.

EAA

U.S. BUREAU ENTOM.
20 AUG 1916

Connecticut Agricultural Experiment Station



E. H. JENKINS, Director

SPRAY CALENDAR

W. E. BRITTON, Entomologist

1117. BUREAU ENTOM.



RECEIVED
20 AUG. 1916
NEW HAVEN, CONN.

1916

BULLETIN 199

G. P. CLINTON, Botanist



1918

CALENDAR

1918

JANUARY

S	M	T	T	W	T	F	S
		1	8	9	10	11	5
6	7	14	15	16	17	18	12
13	14	21	22	23	24	25	19
20	21	28	29	30	31		26
27	28						

APRIL

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7	8	16	17	18	19	5	13
14	15	23	24	25	26	12	20
21	22	30				19	27
28	29					26	

JULY

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14	15	23	24	25	26	12	20
21	22	30	31			19	27
28	29					26	

OCTOBER

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13	14	21	22	23	24	11	19
20	21	28	29	30	31	18	26
27	28					25	

FEBRUARY

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17	18	25	26	27	28	22	23
24	25						

MAY

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12	13	14	15	22	23	17	18
19	20	21	22	29	30	24	25
26	27	28	29			31	

AUGUST

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11	12	13	14	21	22	16	17
18	19	20	21	28	29	23	24
25	26	27	28			30	31

NOVEMBER

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17	18	19	20	27	28	15	16
24	25	26	27			22	23
						29	30

MARCH

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17	18	25	26	27	28	22	23
24 ^{24/31}	25					29	30

JUNE

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9	16	17	24	25	26	21	22
16	23	24				28	29
23 ^{23/30}	30						

SEPTEMBER

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8	9	10	17	18	19	13	14
15	16	17	24	25	26	20	21
22	23	24				27	28
29	30						

DECEMBER

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1	2	3	4	11	12	6	7
8	9	10	17	18	19	13	14
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FOREWORD.

This is the fourth revision of the Connecticut Agricultural Experiment Station's Spray Calendar gotten out in its present form, the first having been issued in 1904 as Bulletin 142, and the others as Bulletins 159 and 183. The Spray Calendars have been received with such commendation, both within and without the State, that our present War edition has been considerably enlarged both as to text and illustrations. It aims to include brief descriptions, with preventive measures, of such insects and a few lower animals, as well as of fungi and untoward environmental conditions, as most frequently cause injury to the common plants cultivated in this State. Fuller statements concerning these foes will be found under the references given at the end of the various descriptions. While designed primarily to meet Connecticut conditions only, the information is largely applicable to most of our northeastern states.

Hang up the Calendar in a convenient place, near your desk, so that it can be consulted as needed. When it comes to treatment of pests, remember the adage, "A stitch in time saves nine."

GENERAL ORDERS No. 1.

In time of war, military measures are prominent and necessary. Large armies must be raised, trained, equipped and fed. Every soldier must obey orders. Are you a soldier?

"BATTALION, FALL IN!"

Line up and make plans for growing food in 1918. Your country needs your efforts.

"ATTENTION! FORWARD, DOUBLE TIME, MARCH!"

Food will be needed for our soldiers, for our people at home, and for our allies. There is sure to be a demand for it, and it will bring a fair price. Consider what you can do to help. Speed up the preparations. Buy at once your materials, seeds, tools, etc. Prepare for the campaign. Leave nothing undone.

"BATTALION, HALT!"

Stop the waste. Grow not only more food, but grow better food. The enormous amount of damage caused by insects annually in the United States has been estimated at \$1,000,000,000.00 and a similar loss is due to plant diseases. Through proper treatment by spraying and other methods this loss can be greatly reduced. The information given in this calendar will aid you in defeating these enemies. Send specimens and write for further information at any time to

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION,

New Haven, Conn.

DIRECTIONS FOR PREPARING INSECTICIDES AND FUNGICIDES.

FORMULAS FOR INSECTICIDES.

LEAD ARSENATE.

3 lbs. (Paste) or 1½ lbs. (Dry) Lead Arsenate.
50 gals. Water.

Spray upon foliage to kill all chewing insects. May be used with Bordeaux or with lime-sulphur mixture.

PARIS GREEN.

1 lb. Paris Green. 3 lbs. Lime.
100 gals. Water.

Spray upon foliage to kill potato beetle, elm leaf beetle, and all chewing insects. Commonly used with Bordeaux mixture.

POISONED BRAN MASH.

5 lbs. Wheat Bran. 4 oz. White Arsenic or Paris Green.
1 pt. Cheap Molasses. 1 Lemon. 7 pts. Water.

Scatter around in field to kill cut-worms, army worms and grasshoppers.

HELLEBORE.

Dust on the plants, or mix with water, 1 oz. in 2 gals. and spray. For currant-worm and other saw-fly larvae.

COMMERCIAL LIME-SULPHUR.

Winter Spray.

1 part lime and sulphur. 9 parts water.

Summer Spray.

1¼ to 1½ parts lime and sulphur. 45 to 50 parts water.

Use winter spray for San José scale and peach leaf curl; summer spray for fungi, to which, as needed, add lead arsenate to kill chewing insects.

NICOTINE SOLUTION.

½ pint in 50 gals. Water.

Several solutions are now sold containing 40% or more of nicotine. Excellent for killing aphids and other sucking insects. Add soap for a spreader.

KEROSENE EMULSION.

2 gals. Kerosene. ½ lb. common soap.
1 gal. Water.

Dissolve the soap in hot water, add the kerosene, and churn together with pump until a white creamy mass is formed which thickens on cooling. Dilute nine times before using.

MISCIBLE OILS.

Several miscible oils are on the market, such as "Scalecide" and "Jarvis' Compound." Are-used to kill San José Scale, especially on old apple trees. Should be mixed 1 part in 15 parts water.

COMMON SOAP.

1 lb in 8 gals. Water.

Spray upon foliage to kill red spider, aphids and other sucking insects.

CARBON DISULPHIDE.

To kill insects infesting stored grain, in tight bins, use 1 lb. for about 40 bushels of grain. Expose for about 36 hours.

NAPHTHALENE.

Used in the form of moth-balls and "flakes" to keep clothes-moths out of clothing. "Flakes" scattered around the borders of floors and shelves will drive away ants.

FORMALIN FLY POISON.

1 tablespoonful Commercial Formalin.

½ cup Sweet Milk. ½ cup Water.

Mix together and expose in a shallow plate with a slice of bread in it. Flies will drink the liquid, especially if no other moisture is accessible, and be killed.

HYDROCYANIC ACID GAS.

1 oz. Potassium Cyanide.

2 oz. Sulphuric Acid.

4 oz. Water.

For each 100 cu. ft. space.

For dormant stock place the acid and water in an earthen jar in the house, drop in the cyanide and close the house at once for half an hour. Ventilate for ten minutes before entering. In greenhouse use 1 oz. of cyanide for each 1000 cu. ft. of space.

FORMULAS FOR COMMON FUNGICIDES.

COMMERCIAL LIME-SULPHUR.

Winter Spray.

1 part lime and sulphur. 9 parts water.

Summer Spray.

1¼ to 1½ parts lime and sulphur. 45 to 50 parts water.

Use winter spray for San José scale and peach leaf curl; summer spray for fungi, to which, as needed, add lead arsenate to kill chewing insects.

BORDEAUX MIXTURE.

4 lbs. Copper Sulphate.

4 lbs. Fresh Lime. 40 to 50 gals. Water.

Dissolve the copper sulphate in hot water or from a coarse bag suspended in cold water; slake the lime separately and strain. Dilute the latter to about 20 gals., into which pour the copper sulphate, diluted to about 20 gals., stirring the mixture; dilute further to form the forty-five

or fifty gallons; or dilute each to 25 gals., and pour together into barrel. Stock solutions of the copper sulphate and lime, rate 1 lb. to 1 gal. water, can be made separately and used as needed.

SELF-BOILED LIME-SULPHUR.

8 lbs. Fresh Whitewash Lime.

8 lbs. Fine Sulphur. 45 to 50 gals. Water.

Start the lime slaking, sift and thoroughly stir in the sulphur, using just enough water to prevent burning and allow to boil from heat of lime for fifteen minutes. Then dilute and apply.

FORMALIN.

A. 1 pt. (1 lb.) Formalin in 50 gals. water, for sprinkling grain to kill smut.

B. 1 pt. Formalin in 30 gals. water, for soaking tubers to prevent potato scab.

C. 1 pt. Formalin in 12½ gals. water, for soil treatment. Use two-thirds to 1 gal. for each square foot of surface treated; cover for 24 hours after treatment; air afterwards, and stir soil; allow 7-10 days before seeding and 10-14 days before transplanting in this soil.

FORMULAS FOR LESS-USED FUNGICIDES.

OTHER BORDEAUX MIXTURES.

Dilute Bordeaux Mixture. Use 1 lb. copper sulphate, 4 of lime, and make as above directed. For second and third sprayings of apples to lessen russetting of the fruit.

Soda Bordeaux Mixture. 4 lbs. copper sulphate, 1¼ to 1½ lbs. soda lye, 50 gals. water. Use only enough lye to make the solution alkaline to test paper. Used sometimes for late spraying of grapes, etc., where spray sediment is objectionable.

Resin Bordeaux Mixture. Melt 5 lbs. resin with 1 pt. fish oil over fire, cool slightly, add 1 lb. soda lye, stirring. Add 5 gals. water and boil till the mixture will dissolve in cold water. Mix 2 gals. with 48 of Bordeaux mixture. Used sometimes on such glaucous plants as asparagus, cabbage, onions, etc., to make a more adhesive spray.

POTASSIUM SULPHIDE.

3 ozs. Potassium Sulphide. 10 gals. Water.
Used chiefly in greenhouses, or for powdery mildews.

AMM. SOL. COP. CARBONATE.

5 ozs. Copper Carbonate.
3 pts. Ammonia. 45-50 gals. Water.

Use *just enough* ammonia (if strong, dilute with several volumes of water) to dissolve the copper carbonate; then dilute to final volume. This fungicide is not as good as Bordeaux, but is used to avoid sediment on the foliage or fruit.

COPPER SULPHATE.

2 to 3 lbs. Copper Sulphate. 45-50 gals. Water.
Used chiefly as a winter spray. 1 lb. to 250 gals. water is sometimes used on foliage. Now rarely used.

COPPER LIME-SULPHUR.

2 lbs. Copper Sulphate.
1 1/2 gals. Com. Lime-Sulphur. 45-50 gals. Water.

Dissolve copper sulphate in part of the water, and then add with the lime-sulphur to the remainder. Apparently a good fungicide but likely to russet apples as does strong Bordeaux.

SULPHUR MIXTURE.

Various commercial forms of Sulphur as "Aromatic Sulphur" and "Sulphur Paste," have fungicidal value, and have been used by us for summer spraying of peaches with little or no injury, at the rate of 8 lbs. to 45-50 gals. of water.

FORMALIN FUMES.

3 pts. Formalin. 23 ozs. Potassium Permanganate.
For each 1000 cu. ft. Space.

Place bulbs or tubers in 6 to 12 in. crates so fumes can get at them. To prevent injury to potatoes, fill space at rate of 167 bu. Place Formalin in large pail in cleared central space and drop in the crystals of potassium permanganate. Close room air-tight for 24 to 48 hours.

INSECT AND FUNGOUS PESTS OF CULTIVATED PLANTS.

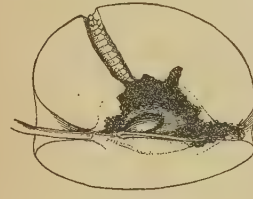
APPLE.

Bud-Moths: **Case Bearers:** **Leaf Crumpler:**—Small overwintering caterpillars feed upon the unfolding leaves. Spray with lead arsenate as soon as leaf buds begin to open. Repeat a few days later, if necessary. Rept. 1909, p. 353.

Canker-Worms:—During May small looping caterpillars devour the leaves and spin down on threads when disturbed. Spray foliage with lead arsenate before blossoms open, and again soon after they fall. In unsprayed orchards sticky tanglefoot bands should be placed around trunks of trees in October, kept sticky until January 1st, and again kept sticky during April and May. Rept. 1908, p. 777.

Tent-Caterpillar:—During May the caterpillars form nests at the forks of the branches, and devour the leaves. Clip off and burn egg masses on twigs in winter. Remove nests with caterpillar brush. Spray with lead arsenate once before the blossoms open and again soon after they fall. Bull. 177, and Rept. 1913, p. 226.

Lesser Apple Worm:—Larva feeds on exterior of nearly mature fruit, and often causes injury in storage. Spray as for Codling-Moth. Rept. 1910, p. 595.



Codling-Moth or **Apple-Worm**—Pink caterpillar tunnels inside the fruit, especially around the core. Spray with lead arsenate as soon as the blossoms fall. Repeat three or four weeks later. Keep foliage and fruit covered until fruit is nearly grown. Rept. 1910, p. 594.

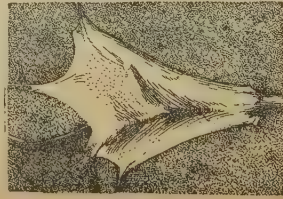
Brown-Tail Moth: **Fall Web-Worm**—See Pear.



Gipsy Moth—Occurs in the United States only in south-eastern New England. Brownish hairy caterpillars defoliate trees in May and June. Band trees with tanglefoot, and with burlap, which should be examined each day to destroy caterpillars. From August to May egg-masses can be destroyed by soaking them with creosote. Spray foliage with lead arsenate. Bull. 186; Repts. 1905, p. 246; 1906, p. 235; 1907, p. 300; also placard.

Curculios:—Grubs of both apple and plum curculios infest the fruit, making it gnarled and ill-shaped. Spray twice after blossoms fall as for Codling-Moth, and remove infested fruit in thinning. Rept. 1904, p. 219.

Green Fruit Worms: **Palmer Worm:** **Leaf Roller:** **Caterpillars** all feed upon foliage and immature fruit. Spray with lead arsenate, as for Codling-Moth.

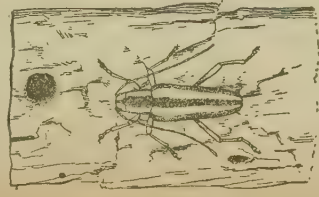


Leaf-Blister Mite—See Pear.

Tussock Moths—Tufted caterpillars of several species feed upon the leaves in mid-summer. Spray with lead arsenate as for Codling-Moth. Rept. 1905, p. 230; 1907, p. 332; 1916, p. 105.

Yellow-necked Caterpillar: Red-humped Caterpillar—Feed in clusters and often strip young trees in fall. Hand-picking is easy method of control. Spray leaves with lead arsenate. Rept. 1901, p. 274.

Maggot or Railroad Worm—Maggots tunnel through the pulp of the ripening fruit of sweet and sub-acid varieties, especially those ripening early in the season. Destroy all infested fruit. Rept. 1910, p. 593.



Round-Headed Borer: Flat-Headed Borer—Grubs burrow in wood at base of trunks. Watch trees and dig out borers wherever sawdust appears. Paint trunk with lead arsenate and lime-sulphur. Rept. 1907, p. 333.

Leaf Hoppers—Whitish insects sucking sap from underside the leaves. Spray with nicotine solution, as for aphids.

Tarnished Plant Bug—Injures developing fruit by sucking sap, forming dimples. Spray with nicotine solution as for aphids.

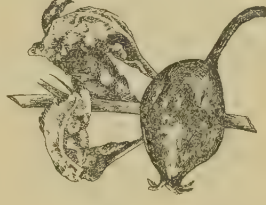
Red Spider: Clover Mite—Cause much injury to leaves, especially in dry seasons. Spray with kerosene emulsion or nicotine solution as summer treatment. Eggs of latter species killed by lime-sulphur spray in winter.



Green and Rosy Aphids—Green aphids suck sap from the leaves and terminal shoots, causing leaves to curl and checking growth. Rosy aphids infest fruit clusters, checking development. Spray with nicotine solution ($\frac{1}{2}$ pint in 50 gallons water), either separately or in combination with lead arsenate, lime-sulphur or Bordeaux Mixture. Repts. 1903, p. 259; 1909, p. 343.

San José Scale—See Peach. Spray dormant trees with lime-sulphur or miscible oil. Bull. 165; Rept. 1904, p. 221.

Red Bugs—Two species of red leaf bugs suck the sap, causing leaves and fruit to become distorted. Spray with nicotine solution, as for aphids.



Woolly Apple Aphid—A bluish-white, cottony plant louse in colonies on bark, forming galls or swellings on twigs of small trees, and preventing wounds from healing; also on roots, forming galls, and destroying small feeding roots. Plant only clean or fumigated stock. Use tobacco dust in soil around trees. Spray above ground with kerosene emulsion.

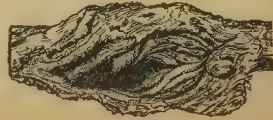


Oyster-Shell Scale: Scurfy Scale—Scale insects with elongated or pear-shaped shells, on bark, suck sap from the twigs; the former about the same color as the bark, the latter light gray or whitish. Spray with nicotine solution; soap and water; or kerosene emulsion, about the second week in June. Bull. 143; Rept. 1903, p. 225.

Fungi, etc.



Baldwin Spot—Shows as small diseased masses of brownish tissue, usually a short distance beneath the skin; finally may appear at the surface as small, discolored, shrunken areas, then very similar in appearance to some of the fruit speck troubles. Not a fungus, but apparently a physiological disease. Thought by some to be due to unusual local loss of water; possibly may start from punctures of Rosy Aphis or similar puncturing insects. No remedy known.



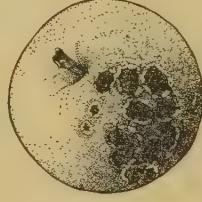
Cankers—Occur on branches and are caused chiefly by European canker fungus which eventually forms a cavity surrounded by concentric elevated rings of wood extending to bark, which each year is killed a little further, adding another ridge. Cut off infected branches, or cut out infected wood and bark; paint over cut surfaces. Keep orchard well sprayed and trimmed. Rept. 1903, p. 299.

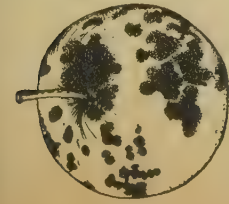
Black Rot—Causes mature fruit to rot, eventually turning it black; forms small brown spots on leaves; does some damage through cankers on branches, which are eventually killed. Treat as for Scab; prune and burn all dead limbs and twigs; cut out and paint over large cankers when found. Rept. 1909-10, p. 590.

Fruit Specks—Form more or less numerous, small, brown or black spots, starting at surface of fruit and slowly working inward; the true Fruit Spot often has a pinkish or purplish border in light-skinned varieties. Due to various fungi. Usually controlled by spraying as for Scab. Rept. 1909-10, p. 590.

Rust—Shows as orange-colored blotches on leaves, eventually producing minute fringed clustered-cups imbedded on the under side; less frequent on fruit. Rust spreads to the apple from the *cedar-apples*, which appear in the early spring on the red cedar. All cedars near the orchard should be destroyed. There is great difference in the susceptibility of different varieties to this disease. Spraying is only partially successful in this state, as the leaves must be well coated continuously with spray from the time they begin to unfold, until the end of July. Repts. 1891, p. 161; 1909-10, p. 591.

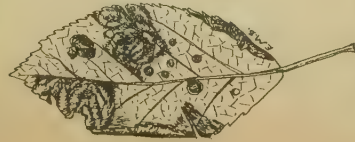
Scab—Produces "scabby spots" on fruit and leaves; rarely on twigs. Spray the unfolding leaves before the blossoms open, again after the petals fall, and follow with a third spraying about four weeks later. For first treatment, use strong Bordeaux, for second and third, weak Bordeaux or lime-sulphur. Rept. 1909-10, p. 591.



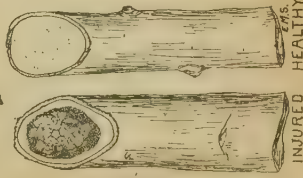


Sooty Blotch—Forms on fruit an olive-black superficial growth in distinct round colonies, or often merging together. Spray with Bordeaux as for Scab, or with lime-sulphur $1\frac{1}{2}$ to 50. Repts. 1909-10, p. 592; 1911, p. 367.

Blight—See Pear.



Spray Injury—Takes the form usually of burn on leaves and russetting on fruit. Is most likely to occur after second and later sprayings. Worst in wet seasons. Spraying in bright sunshine may cause some scorch of fruit on sunny side. Varies greatly with different sprays. Avoid those known to be injurious or injurious combinations (as soap and lead arsenate); use Bordeaux only for *first* summer treatment or on varieties not especially subject to russetting. Rept. 1911, p. 360.



Winter Injury—Takes various forms from different conditions, such as imperfect fertilization or russetting of fruit following late spring frosts; sun scorch of trunks due to mild winter weather followed by sudden cold; bud and twig killing, frost cracks in trunks, blackened wood, dead roots, etc., following unusually cold winters or unfavorable environment. Set out only hardy

varieties; avoid planting in wet ground or on hill-sides with extreme south or southwest slopes. Head trees low; avoid late fertilization and cultivation; keep earth tight around trunks; use cover crops. Repts. 1903, p. 303; 1906, p. 310; 1914, p. 6.

Storage Rots—Are troubles caused by a variety of fungi. Store fruit, in a dry condition, in a cool well aired place. Do not store in too deep piles or too tight receptacles. Use poorer keeping varieties first, and sort over if necessary. Apples from well sprayed trees keep best. Rept. 1915, p. 426.

General Treatment for Apple Orchards.

For the general control of fungi and insects, on apples in Con-necticut we make the following recommendations:

(1) Winter treatment (spraying dormant trees) is necessary only in the case of the presence of the San José scale, or leaf-blister mite, when commercial lime-sulphur, 1-9, or miscible oils, 1-15, may be used.

(2) As a rule, three summer treatments with a fungicide are necessary to control the fungous diseases, and the last two of these should contain an insecticide. These sprayings should be made as follows: 1st, just before the blossoms open, on the young unfolding leaves (April 27th to May 10th, according to the season and variety); 2nd, as soon as all the blossoms have fallen (May 10th to 30th); 3d, about one month later (usually June 10th to 25th).

(3) Where fungi are not prevalent, especially scab, the first summer treatment may be omitted. Occasionally, perhaps in

alternative years, where fungi are quite inconspicuous, the fungicide may be entirely omitted, and only the two sprayings with lead arsenate for insects given.

(4) For fungicides, we recommend Bordeaux mixture of the 4-4-50 strength for the first spraying, and of the 1-4-50 for the second and third sprayings; or commercial lime-sulphur, used at a strength of $1\frac{1}{4}$ to $1\frac{1}{2}$ gallons per fifty gallons of water, for all three sprayings. The former has better fungicidal value, and the latter is less likely to produce spray injury, especially russetting of the fruit. Where fungi are prevalent, the former might be used, while with varieties russetting badly, as Baldwin, the latter is likely to prove more satisfactory; or use strong Bordeaux for first spraying and lime-sulphur for second and third.

(5) For the insecticide in the above, use lead arsenate, if in the paste form at the rate of three pounds per fifty gallons of the mixture, or if in the powder form one and one-half pounds per fifty gallons.

(6) If canker worms, tent-caterpillar, bud-moth, or brown-tail moth are causing damage, add lead arsenate to the first summer treatment, and if aphids are present nicotine solution should also be included. Nicotine solution may be added to any of the subsequent treatments to destroy aphids, red bugs, tarnished plant bug, etc.

ASH.

Insects.

Oyster-Shell Scale—See Apple.

ASPARAGUS.

Asparagus Beetles, Common and 12-spotted
 ♀—Adults and larvae devour the foliage. Cut everything clean during the cutting season; afterward spray with lead arsenate. Repts. 1902, p. 172; and 1903, p. 276.

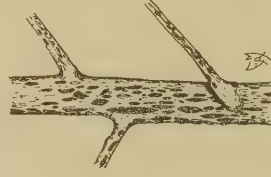
Asparagus Miner—Larvae tunnel under epidermis of stem near base, causing premature death of plant above ground. Burn infested stalks. Rept. 1906, p. 303.

Rust—Produces (most conspicuous stages) small reddish or black elongated pustules scattered over stems. In fall, carefully gather and burn all stems from affected beds and escaped plants in vicinity. In gathering for market cut below the ground, as protruding stems offer opportunity for development of first stage of the fungus. Spraying with Resin Bordeaux partially controls the disease, but this is difficult and expensive. Begin spraying the latter part of July and repeat about every 10 days until the middle of September. Thorough cultivation and fertilization, with plenty of humus in the soil, are advocated as beneficial. Grow varieties most resistant to the disease and select seed for new stock from resistant individuals if found. Repts. 1896, p. 281; 1904, p. 313.

Insects.



Fungi.



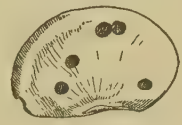
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BEAN.

Insects.

Green Clover Worm—Occasionally green, wriggling caterpillars riddle the leaves in June and July. Dust string beans with air-slaked lime or other fine powder. Spray shell beans with lead arsenate. Rept. 1908, p. 828.

Weevils—Adults lay eggs in the pods in the field and continue to breed in the dried seed, finally rendering it unfit for food or for planting. Fumigate the seed with carbon disulphide, or heat in oven for 1 hour between 120° and 150° F. Bull. 195, p. 6.



Anthraxnose—Shows on leaves and pods as roundish discolored areas, often with a purplish border. Save seed from pods showing no spots and plant these by themselves, selecting each year seed from unspotted pods for the seed crop and using remainder for general crop. Destroy all infected seedlings. Where very troublesome, spray with Bordeaux, beginning when plants are only a few inches high and repeating about every 10 to 14 days until pods are forming. Rotation and destruction of old vines may prove helpful in keeping the trouble in check.



Fungi.

ASTER.

Insects.

Blister Beetles—Three or four species feed upon the flowers, the black one being commonest. Practice hand-picking and cover choice plants with mosquito netting.



Fungi, etc.

Yellows—Shows in the yellowed and often imperfectly developed foliage and one-sided blossoms. A physiological trouble whose cause is not definitely known. Buy best seed; transplant only healthy plants and have soil conditions good. Repts. 1903, p. 306; 1914, p. 413 (26).

BARLEY.

Insects.

Army Worm—See Grass.

Fungi.

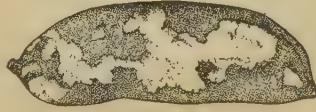
Rusts—See Oats and Wheat.

Smuts—Are of two kinds, covered and loose, both largely destroying the infected spikes and changing them into black, sooty structures, in the latter kind easily dissipated. Treatment, see Oats and Wheat. Rept. 1903, p. 306.



Blight—Appears much like anthracnose, but with discolored areas usually having more of a translucent or watery character. Treat same as anthracnose. Repts. 1898, p. 262; 1903, p. 307.

Downy Mildew—Forms dense, white, woolly growths on pods and less luxuriantly on young stems and leaves of the Lima bean. As the fungus usually appears first and most vigorously in low moist places, the land used should be high or well drained. Serious only in years unusually moist after the middle of July. Spray with Bordeaux, beginning about the middle of July, and repeat every 10-14 days until the first part of September. Rept. 1905, p. 278.

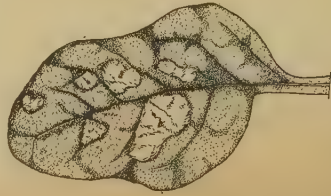


Rust—Produces small, round, reddish or black, dusty outbreaks, usually on the leaves. Plant varieties not likely to rust. Burn the old infected plants in the fall. Rept. 1903, p. 308.

BEE-CHARD.

Insects.

Leaf-Miner—A small fly lays eggs in the leaves, and the larvae tunnel or mine between upper and lower surfaces. Practice clean cultivation. Destroy all infested leaves. Destroy all plants of the weed known as "lambs quarters" in which this insect breeds. Practice late fall plowing.



Fungi.

Leaf Blight—See Mangel. Rept. 1903, p. 309.

BEGONIA.

Eelworms.

Leaf-Blight Eelworm—Produces conspicuous dead areas on the leaves of Begonias (especially var. *Cincinnati*), ferns, etc. Spots vary in size and shape according to host and disposition of larger veins. Buy healthy stock only; keep infected plants by themselves and give them plenty of room; keep leaves as dry as possible and pick off and burn worst infected. Rept. 1915, p. 455.



BIRCH.

Insects.

Tussock Moths—See Apple, Hickory, and Horse Chestnut.

Birch Leaf-Skeletonizer or **Birch Bucculatrix**—Small greenish-yellow larvae feed upon both sides of the leaves in late summer, often entirely defoliating the trees. Spray with lead arsenate in July. Rept. 1910, p. 701.

Bronze Birch Borer—Grub makes spiral tunnel just beneath bark of upper main branches, ridges showing on outside. Cut and burn infested trees before May 1st.

BLACKBERRY.

Insects.

Blackberry Crown Borer—Larva tunnels in roots and at base of stem. Dig out and destroy.

Red-Necked Cane Borer—Larva tunnels in canes causing an irregular swelling or gall, often three inches in length. Cut and burn all infested canes in winter or early spring.

Blackberry Sawfly—Larvae devour leaves in June and first part of July. Spray about June 15th with lead arsenate. Rept. 1912, p. 236.

Fungi, etc.

Crown Gall—Forms hard galls or irregular excrescences on roots and lower parts of stems of blackberries, raspberries and several other hosts. Dig out and burn affected plants as soon as discovered. Never use infected stock for transplanting. A bacterial trouble. Rept. 1903, p. 354.

Leaf Spot—Forms on leaves small circular spots with whitish center and purplish border; also occurs on dewberry and raspberry. Not usually serious but where necessary it probably can be controlled by Bordeaux applied to the leaves, beginning before they have reached their full size. Rept. 1903, p. 309.

Orange Rust—Breaks out in spring or early summer as dusty masses of bright orange spores over the under side of the leaves. The fungus is perennial in the underground parts of the host, so that the disease appears year after year. Dig up and burn infected plants. Rept. 1903, p. 309.



BOX.

Insects.

Leaf-Miner—A small two-winged fly lays eggs in the leaf and the larvae tunnel between the upper and lower surfaces. Destroy infested leaves. Fumigate the plants with hydrocyanic acid gas.

Oyster-Shell Scale—See Apple.

CABBAGE-CAULIFLOWER.

Insects.

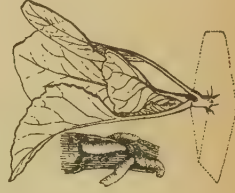
Cabbage Worm—Green worms feed upon leaves all through season. Spray unheaded plants with lead arsenate. Use insect powder or hellebore on headed plants. Bull. 190, p. 9; Rept. 1903, p. 271.



Cabbage Looper—Smooth looping caterpillars feed with cabbage worms late in summer, and require same treatment. Bull. 190, p. 12, Rept. 1910, p. 706.



Cabbage Maggot—Infests stems of early-set plants near surface of ground checking growth and often killing them. Practice crop rotation. Place hexagonal tarred paper disks around stems at setting time. Treat with carbolic acid emulsion. Bull. 190, p. 3; Repts. 1908, p. 832; 1914, p. 142; 1915, p. 114.



Cabbage Aphis—Sucks sap from the leaves. Spray with nicotine solution or kerosene emulsion. Bull. 190, p. 14.

Black (Bacterial) Rot—Forms black lines in veins of leaves. In time leaves turn yellow and easily drop off, and interior of head develops a general soft rot. As the germs can be carried on the seed, avoid seed from infected fields. If in doubt, treat seed in formalin, 1 part to 240 of water for 15 minutes. Keep refuse from diseased plants out of manure; practice rotation; make seed bed in new soil if disease appears in old one. Rept. 1912, p. 345.



Club Root—Causes knob-like enlargements on the roots of cabbage and allied plants. The germ often becomes established in the soil; when possible avoid such land and the use of refuse from old plants on the soil. Be especially careful that the seed bed is not infected. Infected land, if used, should be treated in the fall with lime broadcast at the rate of 80 bushels per acre and worked in. Rept. 1903, p. 310.

Soft Rot—See Salsify. Report 1903, p. 311.



CARNATION.

Insects.

Green Fly or **Aphis**—Sucks sap from young leaves and buds. Fumigate greenhouse with tobacco, or spray with nicotine solution or with soap and water.

Fungi.

Leaf Mold and **Leaf Spot**—Are two troubles much alike in appearance, producing grayish spots with colored borders on stem, leaves and calyx. Treat as for Rust.

Rust—Produces small dusty pustules, more or less confluent, on the leaves and stems. Select, if feasible, only rust-resisting varieties. Spray in field with Bordeaux, adding 1½ lbs. soap to each 50 gallons (helps mixture to adhere to plants). Select for transplanting only hardy and rust-free specimens. Keep air of greenhouse as dry as is consistent with good growth. One or two sprayings with Soap or Resin-Bordeaux, after transplanting in greenhouse, may be given if desired; for repeated sprayings use potassium sulphide or weak copper sulphate. Rept. 1903, p. 312.

Stem Rot and **Wilt**—Cause the lower leaves first to turn yellow and dry up; then as the stem gradually rots off at its base, the whole plant becomes affected and finally dies. Select cuttings only from perfectly healthy plants, and if necessary start these in sterilized soil and replant out of doors in new land, avoiding excessive use of manure. If disease appears after setting out in the greenhouse, pull up infected plants upon appearance of first symptoms, make liberal application of lime, avoid over-watering, and see that roots are properly aerated. Repts. 1897, p. 175; 1903, p. 312.

CEDAR.

Insects.

Web-Worm—Small brown caterpillars feed upon the leaves which they web together. Spray with lead arsenate.

Cedar-Apple Rust—Appears in spring as conspicuous rounded galls with jelly-like horns bearing spores that carry the fungus to apple and related hosts. Cut off and burn all *cedar-apples*. See Apple Rust.

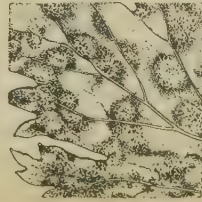


Insects.

Celery Caterpillar—Feeds upon the leaves of celery, parsley, fennel, carrot and parsnip. On the latter two plants lead arsenate may be used. On celery and parsley hand picking is perhaps the best remedy.

Fungi.

Leaf Blight and Leaf Spot—Are two diseases showing “rusty” spots on leaves and petioles; the latter trouble distinguished by the very minute black dots in the discolored spots (fig.), often progressing in stalks after storage. Spray the plants thoroughly in the seed bed with Bordeaux, as infected plants are often the means of introducing the trouble in the field. If necessary, continue the spraying after transplanting at intervals of about two weeks up to the middle of September. Before covering for bleaching, if leaf spot is abundant, dust with sulphur, and before final storage remove infected leaves and dust again. Rept. 1897, p. 167.



Soft (Heart) Rot—Shows as a soft rot of the tissues often confined to the heart. Do not plant in too wet soil, avoid land with green cover crops recently plowed in; in banking allow for proper aeration. See Salsify. Rept. 1914, p. 10.

Insects.

CHERRY.

Cherry or Pear Slug—Larvae eat away the green tissue from upper side of leaf. Spray with lead arsenate or with hellebore.

Canker Worms—See Apple.

Cherry Maggots or Fruit Flies—Larvae of two species infest maturing fruit. Sprinkle foliage with sweetened lead arsenate in early June to kill the adult flies.

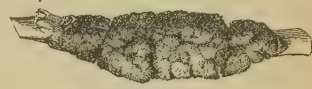
Plum Curculio—See Plum.

Cherry Aphid—A brown aphid which sucks sap from under side of leaves causing them to curl. Spray with nicotine solution, soap and water, or kerosene emulsion.



Fungi.

Black Knot—Forms knot-like excrescences, usually several inches long, on twigs and branches. When planting, use only trees free from this trouble; in the orchard, cut off and burn all infected branches in late fall or winter, painting over large cut surfaces. Cutting *out* knots is rarely advisable, as new outbreaks usually result. In cutting off, cut several inches below the knot, to insure removal of the mycelial threads in



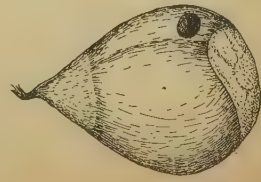
the tissues. Remove all knots each year until they fail to reappear. Spraying in spring and early summer with self-boiled lime-sulphur or atomic sulphur helps to keep new knots from fruiting, but is entirely secondary in importance to the removal of the knots. Rept. 1911, p. 399.

Brown Rot—See Plum. Rept. 1911, p. 402.

Leaf Spot—Shows as numerous, closely placed, purplish spots on leaves, which often have "Shotholes." Spraying, if begun on young leaves early in May, is effective but use the dilute Bordeaux, or better still, self-boiled lime-sulphur to avoid injury to the foliage. Give several sprayings at intervals of two weeks. This helps to keep down the brown rot also. Repts. 1895, p. 188; 1911, p. 401. Also known as Anthracnose.

Powdery Mildew—Develops a cobweb-like growth over the leaves; in fall forms numerous, minute, black fruiting-bodies, especially on under surfaces. Usually worst in young trees; controlled by spraying if necessary.

Insects.



CHESTNUT-CHINQUAPIN.

Canker Worms—See Apple.

Nut Weevils—Long-nosed snout beetles lay eggs in developing fruit and the grubs infest the nuts. Destroy all infested nuts. Fumigate nuts with carbon disulphide as for beans.

Two-lined Chestnut Borer—Long, slender, flat-headed larvae make sinuous tunnels under bark of weakened chestnut and oak trees.

Badly infested trees should be removed and burned, or the bark removed before the insects mature and spread to other trees.

Fungi.



Bark Disease (Blight)—Forms cankers in the bark that eventually girdle infected limb and cause death of parts above. Spreads over tree so that usually it dies within two to five years. Rarely shade trees can be saved by carefully cutting out and painting over the cankers. For forest trees it is best to let the disease take its course, and remove at least the larger trees within a year or two after their death to prevent deterioration of the wood. Rept. 1912, p. 359; Bull. 178.

Insects.

Black Fly or Aphis—Sucks the juice from the young leaves and flower stems. Fumigate the house with tobacco; dip the plants in or spray them with soap and water or nicotine solution.

Fungi.

Powdery Mildew—Develops a white mealy or cobweb coating on leaves. Use good judgment in airing and watering, and if necessary, spray from time to time with potassium sulphide or paint heating pipes with sulphur.

CHRYSANthemum.



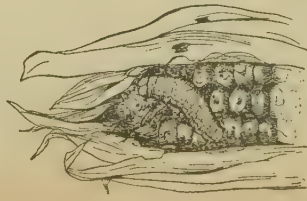
Rust—Appears as dusty reddish-brown outbreaks, about the size of a pin head, chiefly on under sides of leaves. Avoid worst rusting varieties. Start with cuttings free from rust. Destroy rusted leaves, especially on cuttings. Early sprayings with dilute copper sulphate, potassium sulphide, etc., may help to prevent the trouble from getting a start. Rept. 1903, p. 315.

Insects.

Aphis or Green Fly—Sucks sap from the leaves and stems. Use nicotine solution, or soap and water, as a spray or dip.

CINERARIA.

Insects.



Cut Worms—See Tomato.

Army Worm—See Grass.

Corn Ear Worm—Eats the immature kernels at the end of the ear. Dust with equal parts sulphur and powdered lead arsenate.

Fungi.

Leaf Blight—Kills parts of the leaves in August and September much like an early frost. Most injurious in wet late seasons. Plant early maturing varieties and stimulate growth by good fertilization and cultivation. Rept. 1903, p. 317.



Smut—Forms black dusty outbreaks that appear on various parts of the plant. It is especially injurious to certain varieties of sweet corn. Avoid the use of fresh manure on the land. Seed treatment is ineffective. The removal and destruction of spore masses is recommended by some writers.

Insects.

CRANBERRY.

Fireworm or Black-headed Cranberry Worm

—Small, pale green, black-headed caterpillars web the leaves and new shoots together and feed inside the nest. Spray with lead arsenate to kill the caterpillars. Flood the bog for three days to kill the pupae.

Yellow-headed Cranberry Worm—Small, green yellow-headed caterpillars injure plants in same manner as the preceding. Spray with lead arsenate. Keep bogs flooded until about May 20.

Cranberry Fruit Worm—Pale green larvae infest the berries. Flood the bog for about two weeks as soon as the fruit has been harvested. Destroy all infested berries.

Insects.



CUCUMBERS.

Striped Cucumber Beetle—Attacks young plants, eating the leaves. Larvae infest the main root or stem under ground, often killing the plant. Dust leaves with dry lead arsenate. Cover plants with screens. Rept. 1908, p. 807.

Melon Aphid—See Melon.

Fungi, etc.

Anthracnose—Produces prominent discolored spots, more or less merged, on leaves; occurs occasionally on fruit. Treatment is the same as for mildew. See Watermelon.

Downy Mildew—Forms discolored spots as in preceding, but beneath shows a minute thin growth of upright threads bearing dark colored spores. Repeated sprayings with Bordeaux about every 10 to 14 days during the season, beginning at least by middle of July, usually keeps this disease in check. The same fungus occurs on Melons. Rept. 1904, p. 329.

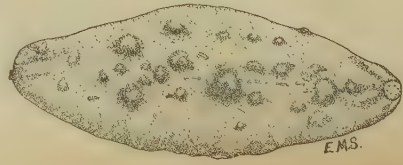
Mosaic and White Pickle—Are two very similar, if not identical, physiological diseases, showing in the former on the leaves as mottling of lighter or yellow-green areas scattered among the normally green tissues, and in the latter causing the fruit to become irregularly shaped, knobbed, and often mottled or whitish in color. Keep down sucking insects that may spread the disease, as it is infectious; pull up and destroy vines first showing it. Rept. 1915, p. 430.

Wilt—See Squash.

CURRENT.

Current Fruit Fly—Small maggots infest the berries, which color prematurely and drop. Destroy infested fruit.

Insects.



Current Worm—Devours foliage in May. Spray with hellebore or lead arsenate. Rept. 1902, p. 170.

Current Borers—The larvae of two species of insects tunnel in the pith of the stems, causing the leaves to droop and wilt. Destroy infested canes during May.

Current Stem Girdler—Adults cut or girdle tip of new shoots after laying eggs in them. Cut and burn these tips at any time of year. Rept. 1896, p. 238.

Current Aphids—Yellowish-green aphids on under side of leaves causing them to curl. Underspray with nicotine solution or kerosene emulsion.

Four-Lined Leaf-Bug—A yellow and black striped bug sucking sap from the leaves. Spray with nicotine solution.

San José Scale—See Peach.

Scurfy Scale—A conspicuous pear-shaped light-gray scale on bark, the insect sucking sap from twigs. Spray about second week in June with kerosene emulsion or nicotine solution. Bull. 143; Rept. 1903, p. 227.

Fungi.



Anthracnose and Leaf Spots—Cause spots on the leaves and usually their premature shedding; the former also spots the fruit of certain varieties. Spray with Bordeaux as the leaves unfold, and repeat at intervals of 10 to 14 days until fruit begins to turn.

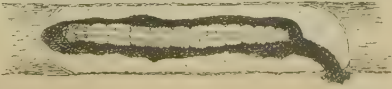
If necessary continue spraying after harvest. Rake up and burn leaves in fall.

Blister Rust—Shows first as dusty orange-colored outbreaks about size of pinhead on lower surface of leaves, and later as short hair-like growths. Worst on black currants. Alternate host is white pine. Report presence to the Experiment Station. Rept. 1911-12, p. 347. See Pine.

Insects.

Leaf-Mite—Transparent microscopic mites cause leaves to curl, and plants do not blossom. Syringe under leaf surface strongly with water. Spray with, or dip plants in nicotine solution, 1 part in 400 parts of water. Rept. 1914, p. 176.

CYCLAMEN.



Insects.

Tarnished Plant Bug—Sucks the sap from the stems and buds causing them to fall. Spray with nicotine solution. Rept. 1904, p. 218.

Stalk Borer—Larva tunnels up and down inside the main stem, the top portion usually wilting and dying. Carefully make longitudinal slit in the stem and kill the borer.

Insects.

Flea Beetle—See Potato.

Colorado Potato Beetle—See Potato.

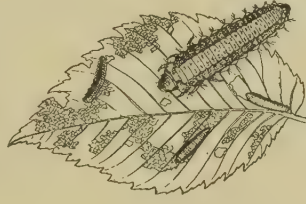
Fungi.

Fruit Rots—Caused by several fungi, the Gray Mold producing the most extensive rot. Spray with Bordeaux; pick off and carry away the rotting fruit.

ELM.

Insects.

Spiny Elm Caterpillar—Clusters of black spiny caterpillars often strip certain branches of elm, willow, and poplar. Remove and destroy entire cluster or spray with lead arsenate. Rept. 1906, p. 260.



Elm Leaf Beetle—Adult beetles eat holes through the leaves in May, and in June and July the larvae or grubs eat away the green tissues from the under surface. Spray with lead arsenate early in May to kill egg-laying beetles, or spray under surface of leaves with same mixture about June 1st, to kill the larvae. Yellow pupae at base of trees may be killed with kerosene emulsion or soap and water. Bull. 155; Rept. 1908, p. 815.

Canker Worms—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

Leopard Moth—Larvae tunnels in branches under the bark, cutting deep galleries, often girdling the branch, which later breaks off and falls to the ground. Small trees may be examined and borers killed by injecting carbon disulphide, or by inserting a wire. Bull. 169; Rept. 1911, p. 317.

EGG-PLANT.

Elm Scale—A large brown soft scale, oval in shape with cottony marginal fringe, located especially in the cracks of the bark of trunk and lower branches, sucking the sap. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 235.

White Elm Scale—A whitish pear-shaped scale on twigs. Spray about June 10th with kerosene emulsion.

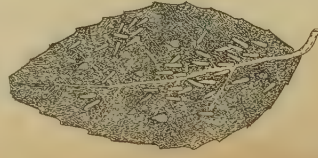
Elm Woolly Aphids—Several species curl the leaves, or form in cottony masses on the bark. Spray with kerosene emulsion. *Fungi*.

Leaf Spot—Shows as black slightly elevated specks more or less thickly imbedded in the leaves and causing their premature fall. Not usually so injurious as to merit the expense of spraying with Bordeaux, which should start on the immature leaves. Rept. 1909-10, p. 717.

EUONYMUS.

Insects.

Euonymus Scale—The various species of Euonymus are attacked and often injured by this scale, which has narrow white (male) or pear-shaped gray or brown (female) shells. Cut and burn infested twigs. Cover and fumigate with hydrocyanic acid gas. Spray with nicotine solution or kerosene emulsion during June to kill young. Bull. 151; Rept. 1905, p. 240.



FERN.

Insects, etc.

Woolly Bears—Several kinds of light brown hairy caterpillars devour the fronds in late summer. Spray with lead arsenate.

Hemispherical Scale—Brown, oval convex scales on fronds of plants under glass. Apply soap and water or nicotine solution as a dip or spray. Bull. 151, p. 9; Rept. 1905, p. 239.

Leaf-Blight Eelworm—See Begonia.

GERANIUM.

Insects.

Greenhouse Leaf-Tyer—Small green wriggling caterpillars feed upon the leaves of plants under glass. Spray with lead arsenate.

White Fly—See Tomato.

Fungi.

Gray Mold Rot—Produces dead spots on leaves and blasts blossoms. Worst in poorly lighted and leaky greenhouses. Keep drippage off plants; avoid watering in cloudy or muggy weather; ventilate. Attacks as a semi-parasite a variety of greenhouse plants. Rept. 1903, p. 322.

GOOSEBERRY.

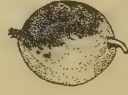
Insects.

Currant Worm—Devours foliage. Apply hellebore or lead arsenate early in season. Rept. 1902, p. 170.

Gooseberry Fruit-Worm—Feeds inside the berry. Destroy infested berries.

Currant Fruit Fly—See Currant.

Fungi.



Mildew—Forms a felt-like growth on fruit and leaves of young shoots. Worst on European varieties, also attacks currant, especially young shoots. Spray with potassium sulphide or other sulphur spray as soon as buds break, and repeat about every ten days until the end of June.

Blister Rust—Not common as yet on cultivated varieties. See Currant.

Insects.

GRAPE.

Grape Vine Flea Beetle—Adults and larvae devour the leaves. Spray with lead arsenate the latter part of June.

Rose Chafer—Long-legged brown beetles appear about June 15th and feed upon leaves, flowers and newly set fruit, often doing great damage. Cover choice plants with netting. Spray heavily with lead arsenate just before blossoms open and if necessary again after fruit has set.

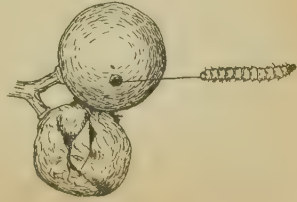
Rept. 1916, p. III.

Grape Plume Moth—Small green spiny caterpillars web together the newly formed leaves at the tips of new shoots. Damage more apparent than real. Crushing by pinching these leaves is the best remedy. Rept. 1914, p. 190.



Grape Berry Moth—Larva feeds and develops inside the berries and is the cause of most wormy grapes. Spray with lead arsenate soon after fruit sets, and repeat twice at intervals of about ten days. Bag the clusters soon after the fruit sets.

Grape Root Worm—Adult beetles eat chain-like holes in leaves in July, and larvae or grubs devour the small feeding roots and eat channels in the bark of the larger roots



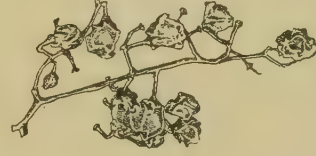
and main stem underground, often causing great injury. Spray leaves with lead arsenate.

Sphinx and Other Caterpillars—Several species of horn worms as well as other kinds of caterpillars feed upon the leaves. Spray with lead arsenate or practice hand picking.

Grape Leaf-Hopper—Small, yellow and red-marked leaf-hoppers sucking sap from under side of leaves. Spray under surface with nicotine solution.

Grape Phylloxera—Sucks sap from roots and leaves, forming galls, and causing serious injury to European varieties. Graft on native species.

Fungi.



Black Rot—Causes reddish-brown spots on leaves; more rarely on stems; especially bad in rotting the berries, which finally become hard, shrunken and wrinkled, black mummies. This is one of the worst diseases of the grape and often difficult to control by spraying, which must be thorough, especially the first season. Begin spraying before blossoming time, about the last of May, with second application just after blossoming and subsequent sprayings at intervals of about 10-14 days. Use Bordeaux up to the last of July and then change to Soda Bordeaux or Amm. Sol. Cop. Carbonate, though usually the 4 or 5 sprayings with Bordeaux are sufficient. Repts. 1889, p. 174; 1890, p. 100.

Downy Mildew—Develops usually dense white patches of fruiting threads on under side of leaves and causes more or less discoloration on the upper; also occurs somewhat on stems and fruit. Treat as for black rot. Rept. 1893, p. 77.

Gray Mold—Causes rotting of ripening greenhouse grapes, covering them with a more or less conspicuous grayish mat of fruiting threads. Remove rotting grapes from the house. Use care in ventilating and watering. If necessary spray bunches several times with potassium sulphide.

Powdery Mildew—Produces a cobweb-like growth over upper surface of leaves; most conspicuous in the fall, when the minute, round, yellowish to black fruiting-bodies are found scattered over surface. Treat as for black rot. Potassium sulphide is also used effectively against this fungus. Rept. 1895, p. 185.

GRASS.

White Grubs—White grubs are the larvae of June beetles, and when abundant in the soil and approaching maturity, cause much damage, especially in seasons following drought, by eating off the roots of grass, corn, strawberries, etc.

Plow just before October 1st to expose insects. Harrow very thoroughly before planting. Rept. 1912, p. 288; 1915, p. 179.

Fall Army Worm—Attack similar to that of army worm but occurs in September instead of July, and is more apt to be confined to lawns and millet. The worm does not migrate in such

great numbers from one field to another. Same remedies apply. Also practice late fall plowing. Rept. 1912, p. 284.

Army Worm—In certain seasons grasses and grains are stripped of leaves and heads during July by brown striped caterpillars, which when abundant move like armies from one field to another often causing great damage. Spray with lead arsenate, strips of grass or grain to protect fields not attacked. Plow deep furrows across line of march. Sprinkle migrating worms with kerosene. Use poisoned bran mash. Rept. 1914, p. 157.



HICKORY.

Insects.

Fall Web-Worm—See Pear.

Walnut Caterpillar—See Walnut.

Hickory Tussock Moth—White and black hairy caterpillars feed upon the leaves in late summer. Spray with lead arsenate. Rept. 1907, p. 332.

Hickory Bark-Beetle—Small black beetles breed under bark and the galleries soon girdle the tree. Adults emerge, leaving numerous round holes as if the bark had received a charge of bird shot. Beetles also feed at base of compound leaf stems causing them to break and fall in midsummer. Has killed thousands of trees in Atlantic States. Badly infested trees should be removed before May 1st, and burned or at least the bark removed. Spray healthy and slightly infested trees about June 1st, with strong

Insects.



lead arsenate and nicotine solution. Repts. 1901, p. 267; 1914, p. 198.

Hickory Borer—Larvae tunnel deep into solid wood of trunk. Hunt for sawdust, find the burrow, inject carbon disulphide, and plug the entrance.

Nut Weevils—Larvae infest the fruit or nuts. See Chestnut.

Hickory Gall Aphid—Curious galls on the leaf stems often cause the leaves to fall in midsummer. Galls contain large numbers of aphids. Spray with nicotine solution just as new growth starts in spring.



Fungi.

HOLLYHOCK.

Rust—Appears as small, compact, reddish-brown outbreaks on both leaves and stems. After their death in fall, cut off the plants close to the ground, carefully gather up these and any rubbish that may contain spores, and destroy them. Spraying with Bordeaux is recommended by some as helpful in checking the rust; begin as plants push through ground. Rept. 1895, p. 188.

HOP.

Insects.

Hop-Vine Borer—Larva tunnels in tip, checking growth, and later in the stem above and below the surface of the ground. Crush larvae in the tips, remove soil from the base, and after leaving the main roots exposed for a week, apply wood ashes or ammoniated phosphate and hill up. The plants will make new roots.

Hop-Vine Snout Moth—Green, white-striped larvae feed upon the leaves in June. Spray with lead arsenate while the larvae are small.

Hop-Merchants—Brown, spiny caterpillars of two species of tortoise-shell butterflies feed upon the leaves. Spray with lead arsenate.

Hop Aphid—Green aphids suck the sap from the under leaf surface. Spray with kerosene emulsion.

Fungi.

Powdery Mildew—Coats leaves and stems with whitish powdery growth, the mature fruiting bodies finally showing as loosely imbedded blackish specks. Found here so far only on ornamental varieties. Make several sprayings with commercial L. & S. Rept. 1911-12, p. 349.



Insects.

HORSE CHESTNUT.

White-Marked Tussock Moth—Tufted caterpillars devour leaves in midsummer. Spray with lead arsenate. Rept. 1905, p. 230; 1916, p. 105.

Fungi.

Leaf Spot—Forms extended reddish-brown areas on the leaves, frequently resembling sun scorch, but showing the fruiting stage as minute black dots in the dead tissues. This trouble can no doubt be controlled by spraying with Bordeaux, if the first application is made on the unfolding leaves and is followed by one or two subsequently on the mature leaves.

HORSE RADISH.

Insects.

Flea Beetle—Adults feed on the leaves, and larvae tunnel in the petioles. Spray with Bordeaux mixture and lead arsenate.

IRIS.

Insects.

Iris Root Borer—Larva tunnels in the rootstocks injuring many plants. Destroy infested rootstocks. In bad infestations burn over the beds in winter to destroy the eggs. Rept. 1915, p. 189.

Fungi, etc.

Leaf Blight—Forms elliptical spots with purplish border; if abundant causes leaves to turn yellow and die prematurely; worst on German Iris. Keep foliage coated with Bordeaux or L. & S., beginning early; gather and burn infected rubbish in late fall.

Soft Rot—Attacks rootstocks destroying lower parts so that leaves turn yellow and die. Same bacterial disease described under Salisfy. Propagate only from healthy stock; plant in well drained soil; use only well rotted manure; prevent winter injury of roots. Rept. 1903, p. 327.



Fungi.

IVY, BOSTON.

Leaf Spot—Forms conspicuous brownish spots with purplish borders, which run together if abundant. Leaf stage of black rot of grape. Give several sprayings with commercial L. & S., beginning on unfolding leaves. Burn leaves in fall.

Insects.

Turnip Aphid—See Turnip.

Fungi.

Black Rot—Rept. 1915, p. 431. See Cabbage.

KALE.

Insects.

Larch Sawfly—Larvae defoliate trees in midsummer. Spray with lead arsenate. Rept. 1915, p. 125.

Woolly Aphid—White cottony tufts on the bark and at the leaf whorls. Spray with kerosene emulsion.

LETTUCE.

Insects.

Aphid or **Green-Fly**—Sucks sap from leaves. Fumigate with tobacco or hydrocyanic acid gas. Spray with soap and water.

Fungi.

Drop—Causes sudden wilting of plants by infecting and rotting off leaves at surface of soil; often shows a white moldy growth over the basal parts. This may develop into a serious trouble in the greenhouse, as the fungus often becomes established in the soil, when the best remedy is to change the soil entirely or sterilize it by steam or formalin (formula C). Treat some days before using. Parsley is also subject to this disease in the greenhouse. Rept. 1908, p. 863.



Leaf Mold and Mildew—The first produces a brownish and the second a white moldy growth in spots on the leaves. These diseases are held in check by sub-irrigation or care in watering and ventilating to keep plants and atmosphere as free from moisture as is consistent with good growth.

Insects.

Lilac Borer—A white larva tunnels in the twigs. Cut and burn infested twigs Rept. 1905, p. 260.

Oyster-Shell Scale—See Apple.

San José Scale—See Peach.

Fungi.

Powdery Mildew—Forms whitish cobwebby coating on leaves, with mature stage finally abundant as black dots. Conspicuous and common, but hardly demands preventive treatment.

LILY.

Insects.

Aphid—Yellow plant lice with red markings, on under side of leaves. Spray with nicotine solution.

Stalk Borer—See Dahlia.

LINDEN.

Insects.

Canker Worm—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

Linden Borer—A white larva tunnels in wood at base of trunk. Dig out borer, or inject carbon disulphide. Rept. 1915, p. 186.

Insects.

Locust Borer—Larvae tunnel in solid wood of trunk. Inject carbon disulphide into the burrow and close the entrance.

MANGEL.

Fungi.



Leaf Blight—Shows as grayish circular spots with purplish borders; when abundant causes premature death of leaves. Rotate; keep refuse out of manure piles; if necessary spray with Bordeaux before disease gets started. Rept. 1915, p. 432.

Root Rot—Rots off roots below ground, turning foliage yellow and often killing it. Not common, but injurious occasionally in low wet fields. Avoid wet ground; keep rotted plants out of manure. Rept. 1915, p. 433.



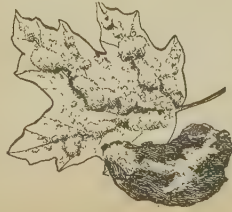
Insects.

Maple Borer—Larva tunnels in spiral course upward around trunk or larger branches of sugar maple working in sapwood and cambium, often girdling the trees. Examine trees in September for sawdust. Find the burrow, inject carbon disulphide and plug the opening. Rept. 1907, p. 336.

White-marked Tussock Moth—See Horse Chestnut.

Other Tussock Moths—See Apple.

Canker Worms—See Apple.



Woolly Maple Leaf Scale—Cottony or woolly masses of wax, containing the females, eggs and sometimes larvae, appear on the under side of the leaves in midsummer; insects suck out the sap causing leaves to fall prematurely. Males and larvae enter crevices of bark of trunk and branches; larvae makes cases here and pass the winter.

Attacks only sugar maples. Spray dormant trees with nicotine solution and soap. Burn all infested leaves. Bull. 151; Repts. 1905, p. 226; 1911, p. 345.

Cottony Maple Scale—Large, oval, brown soft scales on bark of branches of silver and red maples. Each scale in early summer develops a large cotton-like tuft of wax, nearly half an inch long, and soon after the young appear. Spray with miscible oils. Bull. 151; Repts. 1905, p. 237; 1913, p. 252.

Terrapin Scale—Small reddish-brown soft scales on small twigs of silver and red maples, sometimes killing the branches. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 238.

Oyster-Shell Scale—See Apple.

Maple Aphids—Green Aphids are common on under surface of leaves of Norway and Sycamore Maples in June. Spray with nicotine solution or kerosene emulsion.

Fungi, etc.

Anthrachnose—Causes more or less extended dead areas in the leaves, often hard to distinguish from the leaf scorch. Its appearance

depends on character of season and is difficult to foretell, but only occasionally serious. For this reason spraying of doubtful value in the long run, but when made should start on the unfolding leaves. Repts. 1903, p. 329; 1915, p. 436, unusual form.

Black (Tar) Spot—Forms slightly thickened black spots on the leaves, resembling finger prints. Cut-leaf maples are especially susceptible. Rake up and burn all leaves in the fall. Rept. 1908, p. 852.



Leaf Scorch—Causes more or less extended and irregular dead areas to appear suddenly, usually from the leaf margins inward. A physiological trouble due to sudden or excessive evaporation beyond the supply of water furnished by the roots, which is in turn due to abrupt changes in atmospheric conditions, drought, injury to roots, etc. Pruning, when necessary, watering or mulching, and stimulating root growth by nitrogenous fertilizers are probably best remedial measures. Rept. 1905, p. 267.

MARGUERITE.

Insects.

Marguerite Fly or Leaf Miner—A maggot tunnels between upper and lower leaf surfaces. Spray every ten or twelve days with nicotine solution. Rept. 1915, p. 188.

MELON (MUSK).

Insects.

Melon Aphid—Sucks the sap from the under side of the leaves, and when abundant causes much damage. Underspray the leaves with nicotine solution. Rept. 1908, p. 813.

Striped Cucumber Beetle—See Cucumber.

Fungi.

Anthraxnose—Appears occasionally. See Cucumber and Water-melon.



Downy Mildew—Forms angular eventually brown spots in the leaves, often stunting or killing vines; most prominent just before melons ripen, later ones often not maturing or worthless because lacking flavor. It is questionable whether this trouble can be

controlled effectively and profitably by spraying during a very moist season. During dry or semi-moist seasons, however, results are satisfactory, so we recommend spraying as one of the regular operations of melon growing. It should be started soon after the vines begin to run, at least by the middle of July, and the vines should be kept covered with the Bordeaux to the end of the season. Rept. 1904, p. 329.

Leaf Mold—Develops dead spots on the leaves very similar to those caused by downy mildew. Spray with Bordeaux on the first running vines and repeat every 10 to 14 days, making 4 or 5 applications according to season. Repts. 1895, p. 186; 1898, p. 225.

Wilt—See Squash.

Insects.

Fall Army Worm—See Grass.

NASTURTIIUM.

Insects.

Aphid—Brown aphids cluster on stems and leaves sucking the sap. Spray with nicotine solution.

OAK.

Insects.

Canker Worms—See Apple.

Brown-Tail Moth—See Pear.

Orange-striped Oak-Worm—Black and orange striped caterpillars feed upon the leaves late in summer. Spray with lead arsenate.

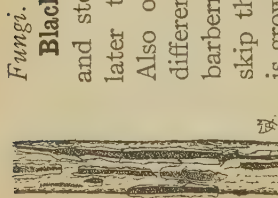
Fungi.

White Heart Rot—Forms on trunks shelf fungi, often somewhat hoof-shaped, eventually with dark, creased and cracked, upper surface and rusty-brown, porous, fruiting, lower surface. Gains entrance through wounded and dead branches; causes white rot of heart wood and slow death of sapwood and bark. Break off and burn fruiting bodies; if feasible cut out diseased bark and sapwood, and dig out dead heartwood and fill cavity with cement. Occurs in other deciduous trees.

OATS.

Insects.

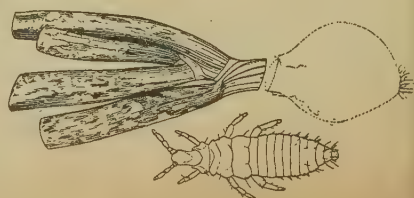
Army Worm—See Grass.



Fungi.

Black Stem Rust—Forms, chiefly on leaf sheaths and stems, first the II stage as reddish pustules and later the III stage as elongated black outbreaks. Also occurs on wheat, rye, and other grasses as different strains. The I stage appears in spring on barberry leaves as cluster-cups but the fungus can skip this stage. Quite serious in regions where grain is grown extensively, and difficult to control. This and several related species are becoming more important here as more grain of various kinds is grown.

Smut—Destroys the grain, turning it into a black dusty mass of spores. Seed treatment will prevent this smut. Either soak the seed 8 to 10 minutes in water at 132-5° F., or sprinkle thoroughly with formalin (formula A), stirring the grain so that it is thoroughly wet, and leave in piles for several hours before drying out. Buy seed from smut-free fields.

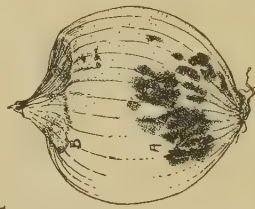


Insects.

Thrips or "**White-Blas**"—Very small insects which feed upon the surface of the leaves, giving the field a whitish appearance. Burn all tops and refuse; burn over the grass land around the field to kill over-wintering insects. Spray with nicotine solution or kerosene emulsion. Repts. 1903, p. 266; 1913,

p. 233.

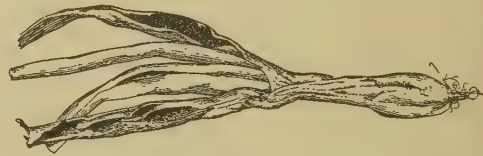
Maggot—Infests the bulb of the young plant. Practice rotation of crops. Spray plants here and there over the field with sweetened lead arsenate to kill the adult flies. Rept. 1911, p. 286.



Fungi, etc.

Anthracnose (Black Spot)—Produces black circular spots on the bulbs, usually on white varieties after storing in the barn. Store onions as dry as possible and keep barn dry and cool. Avoid piling too deeply in bins. Possibly air-slaked lime mixed with sulphur scattered over them at time of storing may prove beneficial. See Stem Rot for treatment with formalin fumes. Fig. (A). Rept. 1889, p. 163.

Smut—Forms black dusty outbreaks on various parts of plants raised from seed; especially injurious to the very young seedlings. This fungus becomes established in the soil, hence infected land should be avoided or used only for transplanted onions. If, however, it is seeded, apply with the seed in drills per acre, 100 lbs. sulphur thoroughly mixed with 50 lbs. air-slaked lime. Formalin (1 lb. or 1 pt. to 12 or 15 gallons water) thoroughly sprinkled over the seed, before covered, by drip attachment to the seeder, is an even more desirable remedy. Rept. 1889, p. 129; 1895, p. 176.



ONION.

Brittle—Causes very young seedlings in the field to die suddenly; others show irregular curling and yellow spotting of leaves. The cause of this trouble is not definitely known. It usually starts in fields in spots which enlarge year after year until the land is worthless for onions. Experiments indicate the value of treating the land, when the seed is sown, with formalin or with sulphur and lime, as for smut. Rept. 1906, p. 332.

Stem Rot—Causes rotting of bulbs at stem end, where they become soft and shrunk, sometimes showing beneath the layers a dense olive-brown growth of mold. This fungus in a moist season occurs on various parts of the plant in the field (possibly responsible for "blast" of seed onions), but does not usually appear as a serious trouble with the bulbs until some time after they have been placed in the barn. Treat same as for black spot. Late field spraying with Bordeaux shortly before pulling and again while lying in the field, combined with treatment by formalin fumes (See Fungicides) after storing, has given some indications of benefit. Fig. (B). Repts. 1903, p. 334; 1904, p. 321.

PAEONY.

Insects.

Rose Chafer—Adult beetles feed upon blossoms of white varieties. See Grape.

PALMS.

Insects.

Scales—Several kinds of white and brown scales infest the species of palms grown in greenhouses. Apply nicotine solution or soap and water as a spray or as a dip.

Fungi.

Anthraxnose—Frequently causes leaves to die at tip. Fungus inconspicuous, may show as small black imbedded specks oozing pinkish masses of spores. Avoid infected stock or isolate it; pick off and burn worst infected leaves; keep leaves dry and house well ventilated. Rept. 1913, p. 18.

PARSLEY-PARSNIP.

Insects.

Celery Caterpillar—On both hosts. See Celery.

Parsley Stalk Weevil—Larva tunnels in crown of plant. No remedy other than to destroy infested plants. Rept. 1913, p. 232. *Fungi.*

Drop—On Parsley. See Lettuce.

Soft Rot—On Parsnip. See Salsify.

PEA.

Insects.

Green Pea Aphid—Attacks the plants early in June and sucks the sap from the leaves and stems, often causing great injury. Early peas may mature a crop before aphids injure them. Spray vines with nicotine solution and soap. Brush the vines just before cultivating. Repts. 1899, p. 240; 1913, p. 235.

Pea Weevil—The adult lays eggs in the pods in the field and the larvae develop in the seed, emerging through round holes. Fumigate with carbon disulphide. Bull. 195, p. 5.

Fungi.

Leaf Spot and Powdery Mildew—The former shows as roundish spots on both pods and leaves; the latter, as a mealy or cobweb-

like coating on same. Neither seems to be sufficiently injurious here to warrant the expense of spraying.

PEACH.

Insects.



Peach Saw-Fly—Larvae feed upon leaves in June and July. Spray with lead arsenate. Rept. 1907, p. 285.

Peach Borer—Larva tunnels in the base of the trunk. Dig out in late fall and early spring. Paint base of trunk with lead arsenate and lime-sulphur. Rept. 1909, p. 359.

Fruit Bark-Beetle or **Shot-Hole Borer**—Makes minute tunnels under the bark of branches and trunk. Burn infested trees and keep others thrifty. Rept. 1896, p. 240.

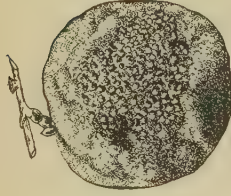
Plum Curculio—See Plum.



San José Scale—Minute scale insects, with circular shell, which suck the sap from twigs, fruit and leaves. On fruit a red spot surrounds each insect. Spray dormant trees with lime-sulphur. Bull. 165; Rept. 1901, p. 240.

Black and Green Aphids—Suck the sap from the leaves and shoots. Spray with nicotine solution.

Fungi, etc.



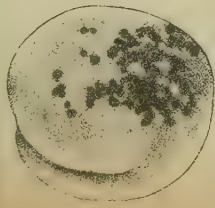
Brown Rot—Occurs on the young twigs, etc., but causes most serious injury to the fruit, rotting it about the time of its maturity. The rotten areas usually become covered with numerous pustules of dusty brownish spores; eventually the diseased fruits form hard mummies. These carry the fungus over the winter, and if half buried in the soil develop in early spring the mature stage, which causes infection of the blossoms, etc. Certain early varieties, like the Champion, are especially subject to rot. Spraying these apparently pays in this state. See general directions for treatment. This fungus occurs on plums and cherries and less commonly on pears and apples. Repts. 1909-10, pp. 607, 612; 1911, pp. 374, 391.

Crown Gall—See Plum.

Leaf Curl—Causes young leaves to become irregularly curled and swollen and finally to drop off; rarely on fruit. In April as soon as buds begin to swell, spray the trees thoroughly with commercial lime-sulphur 1-9. If more convenient this may be done in late fall and is claimed to be just as effective. Same treatment takes care of San José Scale. Repts. 1909-10, pp. 608, 612; 1911, p. 374; 1914, p. 19.

Powdery Mildew—Forms a grayish felt on young twigs and leaves. Prune off infected twigs. Give winter treatment as for leaf

curl, and, if necessary, summer treatment as for scab and brown rot.



Scab—Produces roundish, olive-black spots on the fruit, discolored areas on the young twigs, and rarely “shot-holes” in the foliage. Two treatments with self-boiled lime-sulphur, atomic sulphur or sulphur paste upon the fruit after setting and when half grown (about the middle of May and June) will control this trouble. Repts. 1896, p. 269; 1909-10, pp. 608, 614; 1911, pp. 375, 391.

Spray Injury—Is more likely to occur with same treatment than on apple, which see. Avoid Bordeaux altogether. See (3) under general treatment following. Repts. 1900, p. 219; 1911, p. 372.

Winter Injury—Shows in various ways. In severe winters, especially when the ground is bare, the roots may be killed without injury to parts above the ground. In spring such trees put forth a scanty sickly foliage that soon drops. Often the injury occurs in the form of a “collar girdle” in the bark at the base of the tree. Sometimes it occurs above ground in the wood (shown by its blacker color), with or without injury to the bark. When the bark is not injured, severe pruning in spring will often save the trees. Nursery trees can sometimes be cut back to the snow line, below the injury, and an entirely new healthy trunk started. Avoid late applications of nitrogenous fertilizers and cultivation after middle of July. Mulch base of young trees in late fall with earth. Secure good drainage. See Apple. Repts. 1903, p. 341; 1908, p. 872.

Yellows—Causes premature ripening and red spotting of fruit with yellowish curled leaves, and in time spindling sprout growths in bunches on the trunk. This is claimed to be a contagious disease, but it is apparently physiological in nature. Little peach in this state is scarcely to be distinguished, showing chiefly in the small backward fruit. Root out and burn all trees as soon as found; prevent winter injury; be careful in selecting stock for planting. Repts. 1893, p. 92; 1908, p. 872.

General Treatment for Peach Orchards.

(1) Spraying of peaches while dormant is of value only in checking San José scale, mites and leaf curl. One application of commercial lime-sulphur, 1-9, either in late fall or early spring, will take care of all of these troubles at the same time. If the scale and the leaf curl are unusually prevalent, both applications will prove of value in controlling them.

(2) For the prevention of scab and rot of peaches, it is as a rule desirable to give three sprayings, as follows: 1st, shortly after the blossoms have fallen (May 15th to May 25th); 2nd, about three or four weeks later (June 5th to June 15th); and 3d, about one month later (July 5th to July 15th). If only two sprayings can be given, omit the first if spraying only for rot, and the last if spraying only for scab.

(3) On the whole, self-boiled lime-sulphur of the 8-8-50 formula seems to be the safest and most reliable peach spray. Fair results have been obtained with some of the commercial lime-sulphurs, and they are much more easily handled. There is, however, some danger of spray injury, especially with certain

brands. If commercial lime-sulphur is used, a strength of not greater than 1-150, without poison, is recommended. Atomic sulphur and sulphur paste have given good results.

(4) As lead arsenate has done little to prevent curculio injury, and as it seems to increase the danger of spray injury, we advise leaving it out unless there is considerable danger of sawfly injury, when it can be added in the second spraying the same as for apples.

Insects, etc.

PEAR.

Pear or Cherry Slug—See Cherry.

Codling-Moth—See Apple.

Brown-Tail Moth—Occurs in the United States only in eastern New England. Brown hairy caterpillars feed on leaves, and make winter nests on twigs, maturing about the middle of June. Cut and burn winter nests. Spray foliage as soon as blossoms fall, and also in August, with lead arsenate. Rept. 1910, p. 683; Bull. 182.

Fall Web-Worm—Makes nests on ends of branches of many kinds of trees in late summer, the brown, hairy caterpillars feeding inside the nests. Clip off and burn nests when small. Spray with lead arsenate. Rept. 1901, p. 270.

San José Scale—See Peach.

Pear Psylla—Small jumping plant lice suck sap from leaves and twigs, causing leaves to fall in midsummer. Spray with lime-

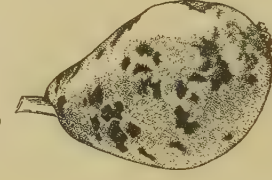
sulphur in spring just before buds open. Spray infested trees with nicotine solution in July. Rept. 1903, p. 262.

Pear Thrips—A minute insect which feeds upon the unopened fruit buds destroying them so that fruit does not set. Spray with nicotine solution just as buds open, and again after blossoms fall.

False Tarnished Plant Bug—Punctures developing fruit causing it to be irregular and knotty. Spray with nicotine solution and soap.

Leaf Blister Mite—Attacks unfolding leaves of apple and pear; forms galls or blisters which become red and later brown. Causes many leaves to fall in July. Spray dormant trees with lime-sulphur in late fall or in spring. Rept. 1910, p. 700.

Fungi, etc.



Scab—Forms olive-black scabby spots on fruit and leaves, often causing the former to become distorted and cracked. The fungus lives over winter on the twigs. Certain varieties are not much injured, others, like Flemish Beauty, are very susceptible. Spray with Bordeaux on unfolding leaves before blossoms open, again after petals fall, and give the third spraying about two weeks later, using weak

Bordeaux in last two treatments. Repts. 1894, p. 135; 1904, p. 323; 1911, p. 396.

Blight—Kills young twigs, the leaves suddenly turning black; also produces sunken dead areas on trunks. This is a bacterial disease chiefly spread by bees during blossoming time, or by



to greatly reduce the damage. Infested leaders should be cut and destroyed. Rept. 1911, p. 307.

Pine Leaf Scale—Whitish pear-shaped shells on leaves; small trees sometimes killed. Spray with nicotine solution or kerosene emulsion about the second week in June. Bull. 151; Rept. 1905, p. 240.

Pine Bark Aphid—White cottony or woolly objects on bark and sometimes on leaves, sucking out the sap. Spray with kerosene emulsion. Rept. 1911, p. 343.

Fungi, etc.

Blight (so-called)—Stunts the leaves and kills their tips inward, often suddenly, so that the tissues for a greater or less distance are reddish-brown. This is a physiological disease; not contagious; due to adverse weather conditions. Chief among these are severe winters, killing the leaves directly or indirectly through injury to roots; warm days, in late winter or early spring when ground is frozen, causing transpiration of water from the leaves that cannot be replaced; very late spring frosts, killing tips of new leaves; sudden changes, in summer from moist or muggy weather to bright sunshine resulting in excessive transpiration and injury; very dry summers. No effective remedy. Rept. 1907, p. 353.

Dampening Off—Caused here chiefly by *Rhizoctonia fungus* rotting base of the stem, the seedling falling over. Sometimes it creeps up the stem invading the base of the leaves which wither. Certain conifers more subject to attack than others. Avoid unnecessary watering; provide good ventilation; infected soil often can be helped by treatment with formalin before seeding

sucking insects. Winter-prune all diseased branches, cutting off several inches below the diseased area. Cut out cankered areas and swab with disinfectant, paint exposed wood when dry. Several weeks after blossoming remove all young dead twigs. Use knife sterilized from time to time by wiping with a cloth saturated with carbolic acid or with corrosive sublimate (1-1,000). This disease occurs also on apple and quince. Rept. 1894, p. 113.

Leaf Blight—See Quince.

PHLOX.

Insects.

Red Spider—Injures leaves causing them to turn yellow. Spray with kerosene emulsion, or with nicotine solution and soap.

Fungi.

Powdery Mildew—Covers more or less completely leaves and young stems with grayish coating within which are finally imbedded numerous, small, blackish fruiting-bodies. Give several sprayings with commercial L. & S., starting before mildew gains much headway.

PINE.

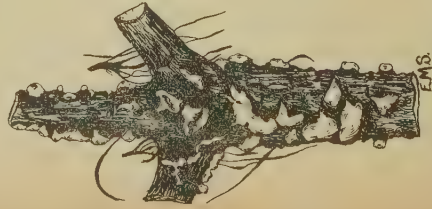
Insects.

Sawflies—Larvae of several native and imported species feed upon the leaves. Spray with lead arsenate.

White Pine Weevil—Adult snout beetle lays eggs on leader in May and grubs feed and develop in it, causing it to wilt and die in midsummer. Leaders of ornamental trees may be protected by spraying them with lead arsenate or lime-sulphur. Jarring the adults into a net once a week during month of May, serves

(see Fungicides, formalin C); spraying with Bordeaux effective in some cases. Repts. 1912, p. 348; 1915, p. 450.

Stem Rusts—Form on the swollen stems temporary, but conspicuous, white, blister-like spore cups filled with a dusty orange-colored spore mass. The white pine blister rust, an imported species, spreads to the gooseberries and currants, and forms other less conspicuous leaf stages on these (*q. v.*). A very similar native species on two and three needle pines spreads to the leaves of the sweet fern. In either case infected pines should be destroyed, and watch kept of the alternate hosts, if they occur in the neighborhood. Seed beds should never be made in the vicinity of the alternate hosts, as infection takes place easily in the young pine seedlings. In white pine plantations pull out all currants and gooseberries including those in the immediate neighborhood (500 feet). Send any suspicious white pines or their alternate hosts to this Station for examination. Rept. 1912, p. 347.



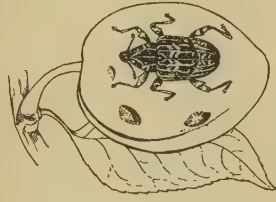
Insects.

PLUM.

Plum Aphids—Suck sap from leaves. Spray with kerosene emulsion, nicotine solution or soap and water.

San José Scale—See Peach.

Plum Curculio—Grub infests the growing fruit, causing it to fall. Jar the trees each morning for six weeks after blooming and catch the beetles on sheets and destroy them. Spraying with lead arsenate during the same period is also advised. Rept. 1910, p. 609.



Fruit Bark-Beetle or **Shot-Hole Borer**—See Peach.

Fungi.

Black Knot—See Cherry.

Brown Rot—Thin fruit so it does not touch. Gather and destroy all mummies after harvest. Rather difficult to control by spraying, as spray does not readily adhere to the smooth fruit. First treatment with self-boiled lime sulphur, should be made on half grown fruit, second 14 days later, and last 10-14 days before picking. See Peach.

Crown Gall—Forms hard roundish knots one-half inch or more in diameter, near crown or on roots, less frequently on lower part of trunk. Do not plant infected trees. Remove knots when found and paint over cut surface. This is said to be very troublesome in some states, but here, as yet, little damage has resulted from it except possibly on blackberries and imported roses. It also occurs on peach, apple, raspberry, and various ornamental plants.

POPLAR.

Poplar Tent-maker—Larvae feed on leaves and fold them together near ends of branches, forming nests. Spray with lead arsenate. Rept. 1911, p. 310.

Spiny Elm Caterpillar—See Elm.

Tussock Moths—See Apple, Hickory and Horse Chestnut.

Poplar Borer—Larvae make large galleries in wood of trunk. Dig out, or inject carbon disulphide into the burrow and close the opening. Rept. 1907, p. 336.

Poplar and Willow Curculio—Larva tunnels in smaller trunk and branches. Destroy badly infested trees. Cut out borers; inject carbon disulphide. Rept. 1907, p. 335.

Oyster-Shell Scale—See Apple.

Fungi.

European Canker—Forms sunken dead areas of varying extent in the bark. Importation from Europe; showing here most commonly on Lombardy and white poplars. If trees are badly injured cut down and burn; otherwise cut out diseased areas going into the healthy bark, scraping, and painting over exposed wood if surface is extended.

Rusts—Show on leaves as minute, powdery, yellow-orange pustules in II stage, and as slightly elevated reddish blisters in III stage. Have I stage, for different species, on larch and hemlock. Avoid planting near these hosts in nursery; rake up and burn infected leaves in the fall. Rept. 1915, p. 449.

*Insects.***POPPY.**

Aphids—Black aphids suck sap from stems and leaves. Spray with nicotine solution.

POTATO.*Insects.*

Flea Beetle—Small black jumping beetles eat holes through the leaves. Spray heavily both upper and under leaf surfaces with lead arsenate. Rept. 1906, p. 271.

Colorado Beetle—Adults and larvae devour the leaves. Spray with lead arsenate as soon as injury is apparent. May be used in Bordeaux mixture. Rept. 1911, p. 311.

Three Lined Potato Beetle—Larvae feed upon the leaves and carry their black excrement on their backs. Spray with lead arsenate.

Stalk Borer—Larva tunnels inside the stalk. Burn infested vines.



Potato Aphid—Green aphids appearing in large numbers suck the sap from shoots and stems, causing much damage in 1917. Spray with soap and nicotine solution.

Fungi, etc.

Black Leg—Causes a black rot of stem below ground; plants more or less stunted

with yellowish curled foliage; occasionally rots tubers. Usually only scattered plants in the field, apparently not spreading to the healthy. Soaking seed in formalin as for scab said to be helpful. Rept. 1914, p. 21.



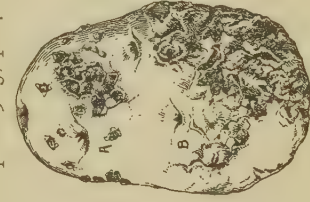
Blight or Downy Mildew—Causes a sudden blackening of the leaves, and often death of vines, from July to September in moist seasons; usually shows a slight whitish growth of fungus on the under side of the leaves; rots tubers. Spray with Bordeaux before the trouble appears, about July 1st, and keep vines well covered to the end of the season. Three to five sprayings by hand or five to seven by power sprayer are necessary. After

last cultivation thoroughly ridge up the rows to help keep the spores from washing down to the tubers. Early varieties often escape blight by maturing before its appearance. Repts. 1904, p. 363; 1905, p. 304; 1909-10, p. 739; 1915, p. 470; 1916, p. 355.

Mosaic—Shows as a more or less conspicuous yellow-green mottling of the leaves. A physiological disease not well understood. New here but apparently not so injurious as in some other places. Do not save tubers for planting from hills showing this trouble.

Powdery Scab—Differs from common scab by smaller, more nearly circular and often powdery spots, with epidermis elevated at margins. Recently imported into Maine; rarely brought here on seed potatoes. Our experiments all indicate that this disease will not propagate in this state under ordinary conditions so it is no longer to be feared. Barely possible on cold wet soils in certain

seasons infection might occur. If necessary, soak seed in formalin as for common scab, and roll in sulphur afterwards. Fig. (A). Rept. 1915, p. 463.



Scab—Produces the common scabby appearance on surface of tubers. Soak seed-tubers one and one-half hours in formalin (formula B). Formalin fumes (see Fungicides) are often used when large quantities are treated. Care in filling space sufficiently, however, is necessary to avoid injury by "pitting" from absorption of fumes. Avoid planting on infected land, by systematic rotation! The use of lime, wood ashes, and various barnyard manures will increase the amount of

Scab. The same trouble occurs on beets and turnips. Fig. (B). Repts. 1890, p. 81; 1891, p. 153; 1894, p. 118; 1895, p. 166; 1896, p. 246; 1909-10, p. 744.

Tip Burn—Causes leaves to die at tip and margins and roll up; often mistaken for true blight. This is a physiological trouble due to drought or sudden change from moist to very hot bright weather. Cultivate thoroughly and often to conserve moisture. Spray with Bordeaux as for Blight, as this often helps to increase yield by lengthening life of leaves.

PRIVET.

Insects.

Privet Leaf Folder—Larvae web together terminal leaves and feed inside. Clip off and destroy infested shoots. Spray with lead arsenate. Rept. 1913, p. 223.

Privet or Lilac Borer—See Lilac.

Fungi.

Anthraxnose—Forms small cankers on stems causing parts above to wilt and die. Usually found in nurseries on recently transplanted European privet. Prune off and burn infected branches; if bad spray with Bordeaux. Rept. 1914, p. 22.

Winter Injury—Shows in spring by stems usually being killed down to base or snow line. Cut off dead stems below injury and a vigorous new growth will result if roots are not injured. Rept. 1904, p. 326.

QUINCE.

Insects.

Round-Headed Borer—See Apple.

Quince Curculio—Grubs infest growing fruit and adults feed upon it causing it to be knotty. Jar the trees same as for plum curculio. Spray with lead arsenate.

Aphid—See Apple.

Fungi, etc.

Black Rot—Rots the fruit, often beginning at the blossom end; also kills twigs and branches. In the fall or spring cut off and burn all dead branches. Give three sprayings, as for Leaf Blight, with Bordeaux mixture.

Blight—See Pear.

Leaf Blight—Forms rounded, often confluent, reddish-brown spots with central black dots on leaves and fruit, the former often shedding prematurely and the latter cracking irregularly. Spray with Bordeaux just before blossoms open, again soon after they

fall, and follow with 1 or 2 additional treatments at intervals of about 2 weeks, according to the weather. This fungus also occurs on pear. Repts. 1890, p. 99; 1891, p. 150.

Rust—Produces small clustered cups, with fringed borders and filled with orange spores, on fruit, young twigs and less frequently on leaves. Cut off and burn infected twigs and fruit. Treat as for apple rust.

RADISH.

Insects.

Maggot—See Cabbage.

Aphid—See Turnip.

Fungi.

Club Root—See Cabbage.

RASPBERRY.

Insects.

Raspberry Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Cane Borer—Larva tunnels inside the canes. Cut and burn infested canes.

Fungi, etc.

Anthraxnose—Shows as more or less confluent whitish spots, with purplish borders, on the stems. In spring, before buds swell, cut out and burn all badly infected canes and then spray with Resin Bordeaux. If disease is very bad, spray again when young shoots are about six inches high, and repeat in 10 to 14 days. Aim chiefly to cover the young shoots with the spray. After fruit is gathered, again remove any badly infected canes. Cultivate

ground thoroughly to promote vigorous growth of canes. Rept. 1899, p. 274.

Crown Gall—See Blackberry.

Rust—See Blackberry.

Wilt—Forms cankered areas on the canes causing the parts above to wilt. In the old canes and near the pruned ends, the fungus often develops a brownish coating of spores around each small imbedded fruiting receptacle. The green berries often dry up without apparent cause, due to inoculation by insects. Spraying has not proved very satisfactory. Old and diseased canes should be removed and burned after the fruiting season and again early in spring. Rept. 1906, p. 321.

Yellows—Causes foliage to become more or less crinkled, and mottled with a sickly yellowish color. Plants gradually become worthless. Spraying does not seem to help this trouble, which apparently is of similar nature to peach yellows. Dig out plants with the yellows. Propagate only from perfectly healthy ones.

RHODODENDRON.

Insects.

Rhododendron Lace Bug—This bug sucks the sap from the under side of the leaves, which are usually colored brown by its excrement. Spray with nicotine solution or kerosene emulsion. Rept. 1910, p. 708.

Fungi, etc.

Leaf Scorch—Shows as dead marginal areas of varying width usually appearing suddenly. Plant in shade; keep ground

mulched; water if necessary in dry weather by soaking ground beneath mulch. Rept. 1914, p. 23.

ROSE.

Insects.

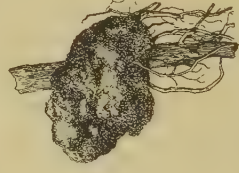
Rose Slug—Eats away the green portion of the leaves. Spray with hellebore, lead arsenate or nicotine solution.

Rose Chafer—See Grape.

Leaf-Hopper—Sucks the sap from the under side of the leaves. Spray with nicotine solution.

Rose Scale—Whitish circular shells on the stems contain insects which suck the sap. Cut and burn worst infested canes. Spray with nicotine solution.

Aphid or **Green Fly**—Sucks sap from the leaves and stems. Spray with nicotine solution.



Fungi, etc.

Crown Gall—Occurs very frequently on rose roots, especially imported ones of Manetti stock. Inspectors now destroy all infected stock. There is some question how much infected plants eventually suffer. See Plum. Rept. 1911-12, p. 355.

Leaf Blotch—Forms large purple-black blotches on leaflets, which often turn yellow and fall off. For greenhouse treatment paint hot water pipes with mixture of sulphur and oil. Potassium sulphide or commercial lime and sulphur can be sprayed on the foliage. Spraying out of doors can be done with Bordeaux, if

there is no objection to the sediment on leaves. Rept. 1903, p. 355.

Mildew—Develops a white powdery or cobweb-like growth on the young leaves, which become more or less distorted and fall off. Tea roses especially susceptible. Treat same as for leaf blotch; or dust flowers of sulphur over the leaves; be careful in airing greenhouses. Rept. 1903, p. 356.

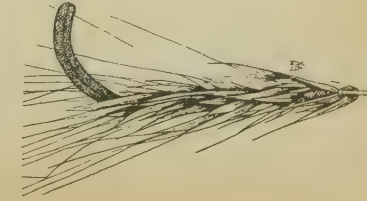
RUTABAGA, See TURNIP.

RYE.

Army Worm—See Grass.

Wheat Midge—See Wheat.

Insects.



Fungi.

Ergot—Forms conspicuous, elongated, purplish sclerotia, usually one in the spike, most common in volunteer rye, but occasionally abundant in cultivated fields. Keep these sclerotia out of cattle feed as they may cause abortion and other troubles.

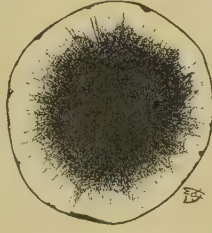
Powdery Mildew—Shows as a thick grayish felt on the leaves with fruiting bodies as blackish embedded specks. Causes

premature death of leaves; often associated with rust. No practical remedy. Rept. 1909-10, p. 735.

SALSIFY.

Fungi, etc.

Soft Rot—Forms a soft rot of the interior tissues of the roots running down from the crown and turning them a darker color. Usually occurs after storage. Same bacteria cause soft rots in a variety of plants. Avoid contaminated manure and too much rotting humus in the fields; store under dry cool conditions, allowing sufficient ventilation. Rept. 1914, p. 25.



SNAPDRAGON.

Insects, etc.

Leaf Mites—Causes leaves to curl and plants do not blossom. Spray with nicotine solution. Rept. 1914, p. 176.

Root - Knot Eelworm—Causes irregular swellings on the roots where the eelworms are present, with resulting premature decay and sickly appearance of parts above ground. Worst in greenhouses and hot-beds as this far north the nematodes are killed in unprotected ground over winter. Attack roots of a great variety of cultivated plants. Purchase only healthy plants; change infected soil if possible, dry out thoroughly in sum-



mer, leave out doors over winter or sterilize with steam; avoid contamination of soil with infected refuse. Rept. 1915, p. 452.

Fungi.

Anthracnose—Shows as whitish spots with distinct purplish border on leaves and stems; spots often running together. Select seed and cuttings only from healthy stock; pick off and burn infected leaves. Spray with Bordeaux.

Rust—Forms reddish-brown, roundish pustules chiefly on under side of leaves causing tissues above to become yellow spotted. Recently appearing in greenhouses and causing more or less injury according to prevalence. Treat as for anthracnose.

SNOWBALL.

Insects.

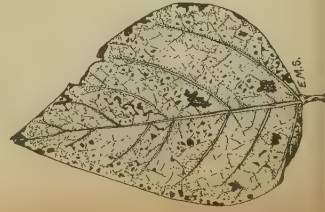
Aphids—Suck sap from the leaves causing them to curl. Use nicotine solution as a spray or dip.

SOY BEAN.

Fungi, etc.

Bacterial Leaf Spot—Forms small, dark, reddish - brown angular spots frequently merging into larger areas. Certain varieties appear more susceptible than others, Ito San being one of the worst. Grow least susceptible varieties and if possible purchase seed from uninfected fields.

Crinkling Chlorosis—Shows as crinkling or yellowish-green mottling of leaves, or



both together. Plants less vigorous than normal ones. Hollybrook variety apt to show trouble most. Treatment same as in preceding.

Insects.

SPINACH.

Spinach or Beet Leaf-Miner—See Beet.

SPIRAEA.

Insects.

Aphids—Suck sap from the new shoots. Use nicotine solution as a spray or dip.

SPRUCE.

Insects.

Spruce Gall Aphid—Forms galls at the base of the new growth on Norway and other spruces. Spray in the late fall or early spring with nicotine solution and soap or with kerosene emulsion. Rept. 1906, p. 302.

Spruce Bud Moth—Larva feeds on leaves of terminal shoots of the branches causing much damage. Spray with lead arsenate. Rept. 1912, p. 291.

SQUASH-PUMPKIN.

Insects.

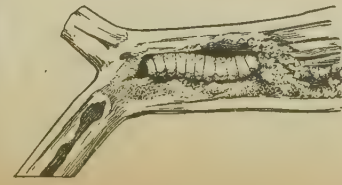
Squash Lady - Beetle—Both adults and larvae devour the leaves. Spray with lead arsenate. Bull. 181, p. 11; Rept. 1908, p. 810.



Striped Cucumber Beetle—See Cucumber.



Squash Bug or "**Stink Bug**"—A brown bug three fourths of an inch in length sucks the sap from the under side of the leaves, causing them to wilt and die. Spray with kerosene emulsion to kill the young. The old bugs may be trapped by placing boards or shingles on the ground, which should be visited each morning and the bugs killed. Rept. 1908, p. 811.



Squash-Vine Borer—Larva tunnels in the base of the stem, causing decay. Cut slits lengthwise in the stem and kill borers. Cover the joints of the vine with earth so that new shoots may be formed to support the plant. Grow a few early plants for traps, and destroy them. The main crop should be planted rather late. Rept. 1908, p. 806.

Fungi.

Anthracnose—See Watermelon.

Storage Rots—Caused by various fungi that are best held in check by storage under conditions with minimum of heat and moisture.

Wilts—Cause leaves of the plants to wilt and then dry up, sometimes all of the vine thus suddenly dying. If a cross section of the stem shows a slight milky and sticky exudation, it is caused by bacteria that clod up the water ducts. Fungi in



the ducts or insects at the roots may cause similar trouble. Heavy manuring often develops these troubles. Spraying is of little value except as it may keep off insects which inoculate the plants with the bacteria. Use enough seed to allow for loss by wilt and pull up and destroy all the wilted vines as they appear. Rept.

1903, p. 359.

STRAWBERRY.

Insects.

Strawberry Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Strawberry Weevil—Small snout beetles; females cut off blossom buds of staminate varieties when ovipositing. Plant pistillate varieties in part. Spray with lead arsenate.

Strawberry Crown Borer—Grub tunnels and feeds in crown of plant. Practice crop rotation. Burn over infested field in fall.

Strawberry Flea Beetle—Adults eat holes through the leaves. Spray with lead arsenate.

Strawberry Leaf Roller—Larva rolls leaf and feeds inside. Spray with lead arsenate. Burn fields as soon as crop is harvested.

Strawberry Root Aphid—Sucks sap from leaves and roots, killing plants. Set clean plants on land not infested. Spray with nicotine solution.

Strawberry Whitefly—Sucks sap from leaves. Underspray with nicotine solution.

Fungi.



Leaf Spot and Blotch—Cause conspicuous discolored spots, the former usually with whitish centers and purplish borders, and the latter with dark centers. Glen Mary sometimes severely injured by latter fungus.

Renew the beds frequently. In the late fall or early spring cut off leaves with mower, add a little straw where necessary, and burn over beds. Spray with Bordeaux two or three times before blossoming, beginning last of April and repeating weekly, and once after blossoming is over. Repts. 1903, p. 360; 1914, p. 5.

Powdery Mildew—Covers leaves (more frequently on under, but more conspicuously, when present, on upper surface) with cobweb-like growth, often causing them to become stiff and curled inward. When necessary, this can probably be controlled with Bordeaux if sprayed before abundant. Rept. 1905, p. 276.

SWEET PEA.

Fungi.

Dampening Off—Rots off stem just below ground causing vines to turn yellow and finally die: Plant in well drained soil; place well rotted manure deep in ground below the seed; avoid excessive watering; spray base of vines and ground with Bordeaux; change beds if appearing yearly. Rept. 1907, p. 359.

SWEET POTATO.

Insects.

Tortoise-Shell Beetles—Feed upon leaves. Spray with lead arsenate.

SYCAMORE.

Fungi.

Anthracnose—Kills young leaves in the spring; causes dead areas of irregular shape in tissues of older ones often following veins. If thought advisable to spray, use Bordeaux on the leaves as soon as showing and repeat when half grown.

TOBACCO.

Insects.

Tobacco or Tomato Horn-Worms—Large green caterpillars with horn on the tail devour the leaves. Practice hand picking or spray the plants with lead arsenate. Rept. 1906, p. 269.

Flea Beetle—Adults eat holes through the leaves. Spray upper and under surface heavily with lead arsenate. Rept. 1906, p. 271.

Cut Worms—See Tomato.

Fungi, etc.

Calico—Causes the leaves to become irregularly mottled with a lighter green color and makes a very inferior tobacco. Frequently infected leaves finally show numerous, irregular, often merging, brown spots known as "rust." While calico is a physiological disease, due to injurious enzymes, it can be communicated to a healthy plant through contact with a very small amount of juice from a diseased plant. Care, therefore, is



necessary after handling diseased plants in touching healthy ones. Never use tobacco water or tobacco stems on the seed beds. If calico shows in a seed bed, pull up all suspicious plants and those surrounding them. If troubled year after year, sterilize the seed beds or change them, and never make them on land used for tobacco the year before. When transplanting, wash the hands occasionally with soap and water. Repts. 1898, p. 242; 1899, p. 252; 1914, p. 357; Bull. 166, p. 10.

Dampening Off—Due to various fungi which rot off the seedlings close to the ground, and cause them to fall over. Keep air of beds as dry as consistent with good growth by care in watering and ventilating. If trouble starts in spots, take out all infected plants and refuse there.

Root Rot—Shows in seed beds by dwarfed "rosette" plants whose roots have been largely rotted off. Occasionally it does more or less damage in fields, especially in alkaline or water soaked soils; a short rotation is advisable in such cases. Sterilize seed beds with steam or treat with formalin (formula C). Repts. 1906, p. 342; 1907, p. 363.



TOMATO.

Insects.

Cut Worms—Eat off plant near ground or climb the plant and devour the leaves. Place around field poisoned bait or bran mash containing arsenic. Trap cut worms with small piece of board. Rept. 1906, p. 264; Bull. 190, p. 18.



Tomato or Tobacco Horn-Worm—See Tobacco.

Flea Beetle—See Potato or Tobacco.

Stalk Borer—See Dahlia.

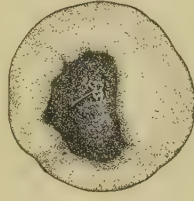
White-Fly—Sucks the sap from under side of leaves. Spray under side of leaves with soap and water. Fumigate greenhouses with hydrocyanic acid gas (1 oz. to 1,000 cubic ft.). Bull. 140; Rept. 1902, p. 148.

Fungi, etc.

Mosaic—Rept. 1908, p. 857. See Calico of Tobacco.

Leaf Spot—Produces on leaves and stems numerous, small, dark spots, often with white centers. Begin spraying with Bordeaux about the middle of July, making 3 or 4 applications at intervals of 10-14 days. This usually develops too late in the season here to cause serious damage.

Point Rot—Causes the green fruit to rot at bloom end, showing a large, firm, dark-brown area. Claimed to be a physiological trouble. Frequently bad in very dry seasons. In greenhouses sub-irrigation is said to prevent it. Spraying, apparently, is of little value. Considerable difference exists in varieties as to susceptibility.



Scab—Occurs most commonly in greenhouses, covering under surface of leaves more or less abundantly with an olive-brown

growth which finally kills the tissue above. Spray with Bordeaux, picking ripe fruit before each of the later treatments.

Wilt—Occurs here chiefly in greenhouses; plants turn yellow and wither up slowly; fungus may finally show on dead stem and fruit as pinkish growth. Caused by fungus clogging ducts and cutting off water supply to leaves; in young stage presence shown by blackened bundles where stems are cut across. Change soil if appearing yearly; do not sow seeds from infected plants as they can carry the disease. Spraying of no value. Rept. 1903, p. 366.



TULIP TREE.

Insects.

Tulip Tree Scale—Large brown hemispherical soft scales on bark, sucking the sap, especially on lower branches. Spray with lime-sulphur when trees are dormant. Bull. 151; Rept. 1905, p. 239; 1912, p. 294.

TURNIP-ROUTABAGA.

Insects.

Cut Worms—See Tomato.

Cabbage Maggot—See Cabbage.

Turnip Aphid—Green aphids on under side of leaves sucking the sap. Underspray with soap and water or nicotine solution. Rept. 1916, p. 98.

Fungi, etc.

Club Root—See Cabbage.

Soft Rot—Causes an interior soft decay of roots, etc., of a variety of vegetables, such as turnips, salsify, parsnips, carrots, celery. Very wet seasons and imperfect storage conditions are usually the starting point of these troubles. Store under best possible conditions for keeping down heat and moisture. Keep contaminated refuse out of manure pile. Rept. 1914, p. 25.

Phoma Rot—Appears usually after storage, causing conspicuous, dry, sunken, subcircular, black spots scattered over roots. Fruiting pustules show as black dots. Store roots in cool dry place and not too deeply in the piles. Practice yearly rotation and keep refuse from manure pile. If necessary, use only artificial fertilizers. Rept. 1912, p. 355.

VIOLET.

Insects, etc.

Violet Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Elworms—Form galls on the roots. Plant in new soil or sterilize the old soil by steam. Add plenty of air-slaked lime to the soil. See Snapdragon.

Fungi.

Spot Disease—Shows as whitish round spots on the leaves. Spray field plants early in fall with Bordeaux. Select only best stock for greenhouse; remove *all* affected leaves before transplanting. When plants become established, spray again with Bordeaux. Be careful about watering plants, and, by proper ventilation and heat during September to November, keep atmosphere of house from ever becoming too moist.

WALNUT.

Walnut Caterpillar—Clusters of black caterpillars covered with whitish hairs strip the branches and finally the trees in August. Spray with lead arsenate. Clip off twigs when caterpillars are small, and kill by crushing. Rept. 1914, p. 191.

Walnut Weevil or **Curculio**—Adults feed at base of leaf stems. Larvae tunnel in new shoots and infest the fruit of Persian and Japanese walnuts. Spray with lead arsenate. Rept. 1912, p. 240.

Walnut Bud Moth—Larvae feed upon tender leaves and shoots, webbing them together. Spray with lead arsenate. Rept. 1912, p. 253.

WATERMELON.

Anthracnose—Shows as more or less abundant, dark, sunken spots or areas on the fruit. Also infects leaves in spots. Usually appears here too near end of season to cause sufficient injury to warrant spraying; spray also fails to adhere well to the fruit. Rotation and removal of rotting melons from field may possibly be helpful restrictive measures.

WHEAT.

Army Worm—See Grass.

Hessian Fly—Maggot burrow in sheath of a leaf at base of stem, causing the stalks to turn yellow and die. Plant rather late—say about September 1st.

Wheat Midge—The fly lays eggs on the chaff and the maggots feed upon the developing kernels, so that the heads ripen early and produce no grain. Burn stubble before plowing. Plow infested fields deeply in the fall.

Green Bug or **Aphid**—Green aphids suck the sap from leaves. Destroy in early fall all volunteer wheat and oats. Practice crop rotation.

Black Stem Rust—See Oats.

Leaf Rusts—Form small, dusty, orange-colored outbreaks on leaves, etc., and later darker and firmer mature stage. Several closely related species on barley, rye, and wheat but quite distinct from the Black Stem Rust. Attempts are being made to secure resistant varieties to these various grain rusts. No effective treatment.

Loose Smut—Destroys entire head turning it into a dusty olive-black mass that is dissipated in time. Severe hot water treatment partially effective. See Oats.

Stinking Smut—Fills the apparently scarcely changed seeds with a dusty mass of spores. Spores often found more or less abundantly in middlings and other feeds containing wheat, and their presence in amount indicates poor quality, and may have some connection with complaints of injury to stock fed on these. Rept. 1909-10, p. 736.



Insects.

WILLOW.

Spiny Elm Caterpillar—See Elm.

Poplar Tent-Maker—See Poplar.

Poplar and Willow Curculio—See Poplar.

Aphids—Large reddish aphids congregate on twigs in fall, and suck the sap. Spray with kerosene emulsion or nicotine solution.

Oyster-Shell Scale—See Apple.

Fungi.

Rusts—Occur on the leaves; similar in appearance and closely related to those on poplar, *q. v.* The alternate host for one species is the larch and apparently there is another whose alternate host is not yet determined. Rept. 1915, p. 450.

Prospective purchasers should write to these firms for catalogues and prices.

MANUFACTURERS OF SPRAYING MACHINES.

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| Aspinwall Manufacturing Co., Jackson, Mich. (Hand and power potato sprayers.) | Field Force Pump Co., Elmira, N. Y. (Hand and power pumps.) |
| Barnes Mfg. Co., Mansfield, Ohio. (Hand and power sprayers.) | Fitzhenry Guptill Co., 135 First St., East Cambridge, Mass. (Power sprayers.) |
| Bateman Mfg. Co., Grenloch, N. J. (Iron Age sprayers for hand and power.) | Friend Mfg. Co., Gasport, N. Y. (Power and hand pumps.) |
| Bean Spray Pump Co., Lansing, Mich.; San Jose, Calif. (Hand and power outfits.) | Goulds Mfg. Co., 58 Pearl St., Boston, Mass.; 16 Murray St., New York. (Hand and power sprayers.) |
| Brackett, Shaw & Lunt Co., Somersworth, N. H., 62 No. Washington St., Boston, Mass. (Hand and power outfits.) | Hardie Mfg. Co., Hudson, Mich.; Hagerstown, Md. (Hand and power pumps.) |
| Brown Co., E. C., Rochester, N. Y. (Compressed air, hand and power outfits.) | Humphries Mfg. Co., Mansfield, Ohio. (Hand and power pumps.) |
| Church, Stephen B., Seymour, Conn., 64 Pearl St., Boston, Mass. (Power and hand sprayers.) | Hurst Mfg. Co., H. L., Greenwich, Ohio. |
| Cushman Sprayer Co., St. Joseph, Mo. (Power outfits.) | Leggett & Brother, 301 Pearl St., New York. (Hand and power dusting machines.) |
| Dayton Manufacturing Co., 2240 East Third St., Dayton, Ohio. (Hand sprayers.) | Myers & Brother, F. E., Ashland, Ohio. (Hand and power pumps.) |
| Deming Co., Salem, Ohio. (Hand and power outfits.) | Niagara Sprayer Co., Middleport, N. Y. (Dusting machines.) |
| Douglas, W. & B., Middletown, Conn. (Hand and power pumps.) | Rumsey Pump Co., Ltd., 49 Federal St., Boston, Mass. (Hand and power pumps.) |
| | Spramotor Co., 107-109 Erie St., Buffalo, N. Y. (Hand and power outfits.) |

MANUFACTURERS OF INSECTICIDES AND FUNGICIDES.

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| Blanchard Co., Jas. A., Hudson Terminal Bldg., 30 Church St., New York. (Insecticides and fungicides.) | General Chemical Co., 25 Broad St., New York. (General insecticides and fungicides.) |
| Bowker Insecticide Co., 43 Chatham St., Boston, Mass., 1011 Fidelity Bldg., Baltimore, Md. (Insecticides and fungicides.) | Grasselli Chemical Co., 80 Maiden Lane, New York. (Insecticides and fungicides.) |
| Devoc & Raynolds Co., Inc., 101 Fulton St., New York. (Arsenical poisons.) | Hemingway & Co., Inc., Bound Brook, N. J. (Arsenical poisons.) |
| Frost Insecticide Co., 20 Mill St., Arlington, Mass. (Spray chemicals and apparatus.) | Interstate Chemical Co., 12-20 Bay View Ave., Jersey City, N. J. (Insecticides and fungicides.) |
| | Kentucky Tobacco Product Co., Louisville, Ky. (Nicotine solution.) |

Lavanburg Co., Fred L., 100 William St., New York. (Arsenical poisons.)
 Leggett & Brother, 301 Pearl St., New York. (Insecticides and fungicides.)
 Mechling Bros. Mfg. Co., Line St., Camden, N. J. (Insecticides and fungicides.)
 Merrimac Chemical Co., 33 Broad St., Boston, Mass. (Lead arsenate.)
 National Color and Chemical Works, Selling Agents for Taylor Chemical Co., 59th St. & 11th Ave., New York. (Carbon disulphide.)
 Niagara Sprayer Co., Middleport, N. Y. (Dusting materials.)
 Pratt Co., B. G., 50 Church St., New York. (Miscible oils.)
 Riches, Piver & Co., 30 Church St., New York. (Arsenical poisons.)

CONNECTICUT DEALERS IN SPRAYING SUPPLIES.

Dealers in spraying materials can usually be found in each town. Some of the larger firms are mentioned below.
 Apothecaries Hall Co., 24 Benedict St., Waterbury. (Wholesale druggists.)
 Barnes Bros., Yalesville. (Insecticides and fungicides.)
 Cadwell & Jones, 1084 Main St., Hartford. (Pumps, insecticides and fungicides.)
 Grasselli Chemical Co., River St., New Haven. (Insecticides and fungicides.)
 Henry & Son, W. A., Blue Hills Farm, Wallingford. (Friend sprayers.)

Robertson Co., The J. T., 147 Richmond Ave., Syracuse, N. Y. (Miscible oils.)
 Roessler & Hasslacher Chemical Co., 100 William St., New York. (Cy-anide.)
 Sherwin-Williams Co., 601 Canal Road, Cleveland, Ohio. (Lime-sulphur and arsenical poisons.)
 Thum Co., O. & W., Grand Rapids, Mich., 15 India St., Boston, Mass. (Tanglefoot.)
 Vreeland Chemical Mfg. Co., 50 Church St., New York. (Insecticides and fungicides.)
 Jewell, Harvey, Cromwell (Agent for Hardie hand and power sprayers.)
 Leete Co., The Chas. S., 299 State St., New Haven. (Wholesale druggists.)
 Lighbourn & Pond Co., 39 Broadway, New Haven. (Pumps, insecticides and fungicides.)
 Platt Co., The Frank S., 845-855 Dixwell Ave., New Haven. (Pumps, insecticides and fungicides.)
 Sisson Drug Co., 729 Main St., Hartford. (Spraying machines and insecticides.)
 Whittlesey Co., The Chas. W., 259-271 State St., New Haven. (Wholesale druggists.)